COLLIDER-ACCELERATOR ACCESS TRAINING

Radiation Safety Associated With The C-A Primary Areas
&
Rad Worker II Module For C-A High Radiation Area Training
&
Conventional Safety Issues At The Complex

INFORMATION GUIDE

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C-A ACCESS TRAINING

LEARNING OBJECTIVES OR WHY TAKE THIS COURSE?

This Course is required if you want unescorted access into C-A primary areas W, X, and Y lines, Collider Tunnel, Assembly, service and Support buildings, AGS Ring, Booster Ring, Linac, Linac to Booster (LTB) Line, downstream Tandem to Booster (TTB) Line, Switchyard, SEB Primary Beam Lines, FEB Primary Beam Lines, V1 Line, Accelerator to Collider Transfer Line, or Target Caves. Primary areas are synonymous with High Radiation Areas, and restricted Radiation Areas, thus require you to have facility specific knowledge.
This course provides you with basic information about the access control system at the C-A. Specifically, this course covers the physical design features and administrative controls that are used to prevent accidental exposures. This information will help you avoid unnecessary radiation exposures when working or passing through a C-A radiological area.

You will learn about the posting and access controls for C-A High Radiation and Very High Radiation Areas. The requirements and permits for entering and working in these areas will be covered. You will also learn about conventional safety issues; for example, Stop Work, working safely with compressed-gas, Enhanced Work Planning, and Oxygen Deficiency Hazards. Additional ODH training is required for access into the refrigerator building 1005R. The response to emergencies and the guidelines for control of emergencies will also be presented.

A pre-requisite for this course is Radiation Worker 1. Please be aware that successful completion of Access Training does not allow you to work in C-A Contamination Areas. Additional "Contamination Worker Training" is required in these areas. Successful completion of C-A Access Training does not allow you to remove activated materials from C-A primary areas without the assistance of Radiological Control Technicians (RCTs).

Question: if an area is improperly entered; for example, by climbing over a shield block or by slipping through a hole in a gate, could you be killed by direct exposure to the beam?

Answer: yes. The beam is intense enough to deliver a lethal dose in a single pulse.

In addition to ionizing radiation hazards, C-A areas may contain hazards posed by:

- heavy objects,
- mechanical equipment,
- overhead cranes,
- heights,
- high magnetic fields,
- hot and cold surfaces,
- steam,
- high-voltage and high-current electrical systems,
- noise hazards
- oxygen deficiency from release of helium, nitrogen, carbon dioxide, or sulfur hexafluoride.
- radio-frequency radiation, and

- contamination and oxygen deficiency from smoke and fire.

We strive to maintain an excellent safety record in such a complex environment without undue inconvenience to the C-A staff. With your help, over the last few years we have significantly reduced fire losses, radiation dose, unusual occurrences, environmental releases and injuries.

We can assure the continuity of this safety record only by having the active cooperation of each individual who has access to the primary areas. Each of you should familiarize yourselves with C-A safety requirements, procedures, and the Local Emergency Plan.

WARNING:

Willful or flagrant disregard of Federal radiation-protection rules may result in disciplinary action, monetary penalties, and / or criminal prosecution.

Question: does C-A Access Training, the training given here, permit you to work in a primary area that is also a Contamination Area?

Answer: no. In order to work in a primary area that is also a Contamination Area, you must be trained in Contamination Worker Training.

As a worker at the C-A facility you will most likely require additional job specific training. This may include lab wide training courses such as Electrical Safety, Cryogenic Safety, Working Hot, Lock-Out Tag-Out, etc. Some training will be given by your supervisor e.g. LOTTO OJT, C-A OPM Procedures, Group Procedures, etc. The C-A Training Manager (x 7343) should consult with your supervisor to determine the training requirements you need. It is you responsibility to maintain your training current. You are not allowed to perform work or operate in areas where you are either untrained or in which you training has expired.

PRICE ANDERSON ACT AMENDMENTS (PAAA)

It is important to make you aware of the absolute requirement to follow all radiation safety rules at C-A facilities. Federal law (PAAA) provides for enforcement penalties if you do not follow the rules fully. Personnel have been the subject of criminal investigations when found to willfully remove a radiation barrier. Thus, we request that you pay particular attention to the radiation safety rules that follow.

Is staff at C-A accepting additional legal liabilities when signing documents related to compliance with radiation safety rules under the Price-Anderson Act Amendments? The short answer is that the employee incurs no personal liability under the provisions of the Act unless he/she intentionally acts to violate the radiation safety rules.

The Price-Anderson Act sets up a regulatory scheme for enforcement of radiation safety rules, including radiation protection standards (10 CFR 835). Failure to comply with those rules, or to identify and report non-compliance to DOE, subjects the Laboratory, not an employee, to an enforcement action.

When signing documents related to radiation safety, an employee is essentially confirming that he/she will do his/her assigned work according to the rules. The signature does not mean that the employee is guaranteeing that the work will be carried out perfectly or that there is no potential for a violation. It does mean that the employee is performing his/her duties to the best of their ability and has made a good faith effort to comply with the radiation safety rules. A "good faith effort to comply with the rules" means that the employee has familiarized him/her-self with the requirements of regulations that fall within his/her area of responsibility. Having done so, he/she should be in a position to approve or sign-off on procedures or training to carry out work involving radiation safety.

WARNING

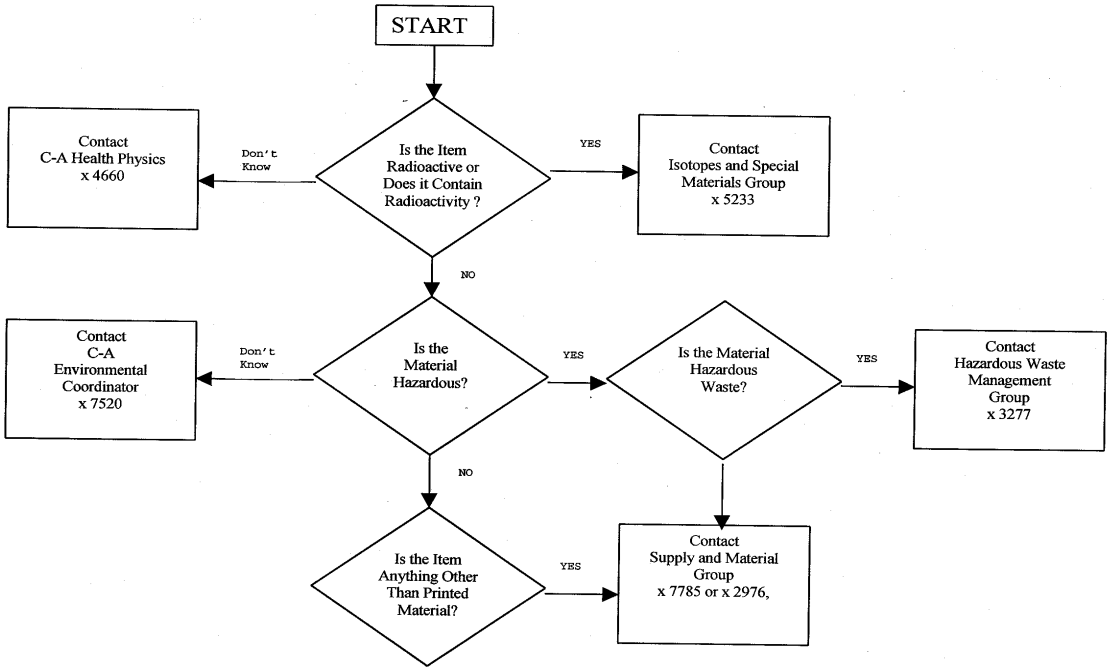
It should be understood that any employee who intentionally violates any regulation, regardless of whether the employee signs any document related to compliance, might be subject to criminal prosecution or other disciplinary action.

DELIVERIES TO C-A FACILITIES

In recent years, the delivery of materials to C-A has become complicated due to our attempt to comply with Price Anderson Act Amendments. Under Price Anderson, we are required by Federal law to obey all radiation safety rules or face stiff penalties if we do not. All persons, including delivery people, who enter Radiation Areas must be wear a TLD and be escorted by a trained Radiation Worker, or they must be a Radiation Worker.

To ensure that DELIVERY PEOPLE DO NOT ENTER RADIATION AREAS, the department requires that all deliveries for the C-A complex be made to building T89. Arrangements can be made with the Main Control Room, (x4662), for off-hour deliveries. When the delivery is made to the MCR, personnel there will then contact the addressee. Under no circumstances are deliveries to be made to other buildings in the C-A complex without approval of the C-A ESH&Q Division Head (x5272, pager 4820) or the ESH Coordinators (x7036, pager 6152 or x 7200, pager 5605) . WHEN PLACING AN ORDER, INFORM VENDORS TO PUT YOUR NAME ON THE PACKAGE (packages arriving without a NAME will be sent back) AND STATE THAT DELIVERIES ARE TO BE MADE TO **BUILDING T89.**

IF YOU'RE SHIPPING FROM C-A TO OFF-SITE, THEN ASK YOURSELF THESE QUESTIONS AND FOLLOW INSTRUCTIONS PRIOR TO SHIPPING



HANDLING LEAD (Pb)

You will encounter Pb in the primary areas. Please be aware that handling Pb may be hazardous and you are required to use protective equipment such as gloves. Pb may be found in brick, sheet, or cast forms, or as wool which is used in Pb blankets. In most applications, the bare metal should be covered or painted if practicable. You need to wear safety shoes in addition to gloves when handling Pb bricks or sheets of Pb. You are not allowed to shape, drill, or otherwise work with Pb in any way that causes it to become dispersible. If you need assistance with shaping or cutting Pb, then contact the C-A ESH&Q Division Head (x5272, pager 4820), or ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152).

East Face of the STAR Magnet
Orange barrier denote 500 Gauss limit.

A 5 Gauss limit is posted on doors of Assembly Buildings, and on warning signs in the Collider tunnel, and building 912.

MAGNETIC FIELDS

Use extreme caution with iron and steel objects when working around magnets with large gaps (e.g., spectrometer magnets). Be sure magnets are not energized before the area is clear. Remember that the field may be effective at a surprisingly long distance.

LASER SAFETY

All lasers on the experimental floor need to be reviewed by the BNL Laser Safety Office personnel prior to initial use or following modification to a previously reviewed laser. Make sure you are aware of the safety requirements established for lasers in your area. Contact the C-A ESH Coordinator (x7200, pager 5605 or x 7036, pager 6152) if you will be installing new lasers

Lasers located at STAR. Interlocks are on all laser enclosures. No beams are exposed during normal operation.

MAGNET WATER COOLING

Magnet water-cooling systems may incorporate electrical buses. They are operated under pressure and required special training to work on. Depending upon the location in the C-A complex, some magnet water-cooling systems may have a radiation field associated with them. They are clearly labeled and should not be handled without proper training and authorization.

Star Magnet Cooling System

HARDHAT POLICY

You are required at the C-A complex to wear a hardhat if you are in an area when an overhead crane is in operation. Do not continue to stand under objects being handled by the cranes.
At STAR you are required to wear a hardhat if people are working above you.
Construction areas require a hardhat at all times. At this time, BAF and PHENIX are construction areas.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Department safety policy states that each workplace should be created and maintained in a manner that minimizes safety and health problems. For some jobs, this is not always practical. In some cases protective clothing and equipment is required for safety. Plan your work in advance. Consider whether PPE may be needed. Contact the C-A ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152) whenever PPE is to be used for approvals and reviews.

FIRE SAFETY

The fire safety program at BNL emphasizes prevention through the design of buildings and automatic protection. If you suspect a fire telephone 2222 or 911, Fire Rescue Group. Once a fire has been reported warn everyone in the area and evacuate as required. If you think you can combat the fire without putting yourself in danger, a fire extinguisher may be effective. **Never let the fire get between you and your escape route**. Use a fire extinguisher only if you are trained and it can be done safely. Only use a fire extinguisher if you're confident in your ability to put out the fire safely. Determine what is burning and select the appropriate fire extinguisher. Fire extinguishers are classified according to their ability to handle specific types and size fires. If you have any doubts, let firefighters handle the situation.

FRAGILE EQUIPMENT

Many experiments at the C-A complex employ many devices and equipment that are fragile such as vacuum windows, scintillation detectors, prototype detectors, electronic cards, connectors and cables. All of these devices require proper training and authorization to perform work on.

All Collider experiments have beryllium beam pipes installed. This material is fragile, and toxic. Protection is provided to prevent physical damage.

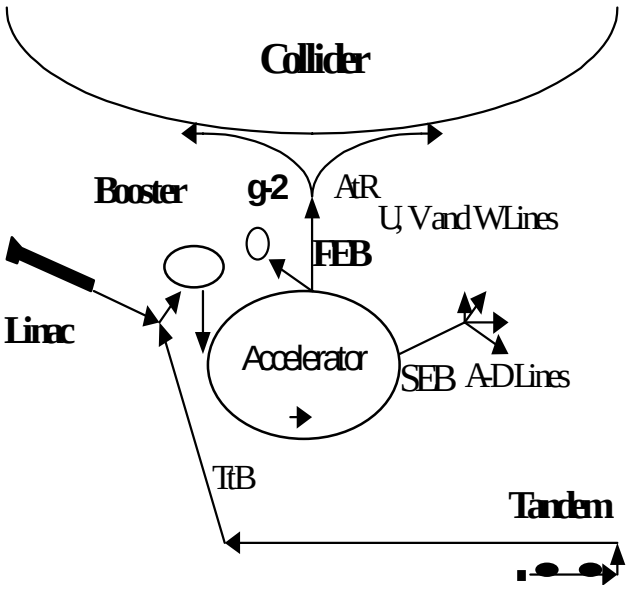
Care is always required in experimental areas to prevent damage to fragile components of the experiment

FACILITY DESCRIPTION

PRIMARY AREAS are areas where beam is fully enclosed. For proton running, this includes the accelerators (Linac, Booster, AGS), plus the switchyard and beam lines up to the proton target stations A, B, B', C, C', D, and V. The switchyard, A, B, C and D beam lines form what is named the SEB (slow-extracted-beam) areas. Beam lines, U, and V form the FEB (fast-extracted-beam areas). For heavy-ion running, primary areas include the tube-like enclosures that directly surround the beam whenever it traverses the experimental areas. Additionally, the structures known as the Tandem to Booster Line and the Accelerator to Collider Transfer Line (AtR), X and Y lines, and the Collider tunnel are also considered primary areas.

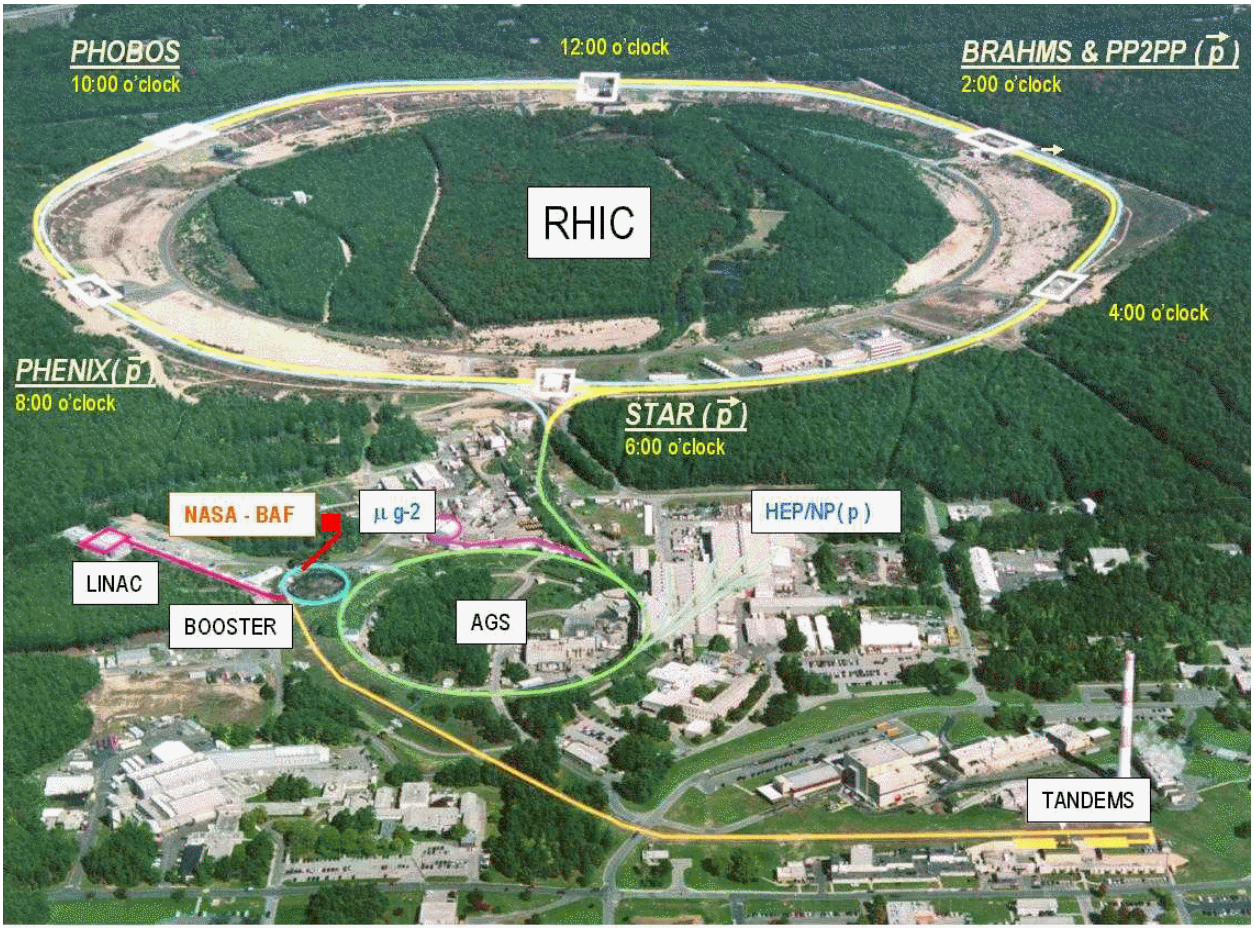
Primary areas are fully enclosed by shielding or fences and have a barrier on the roof. With the exception of tube-like structures for heavy ion beams, they are generally arranged as shielded areas with interlocked gates.

A plan view of these areas is pictured as follows:



Several views of C-A facilities are given on the following pages. Entrance and egress points are indicated along with a view of the radiological areas.

Collider-Accelerator Complex



Accelerators and Collider

TVDG

Linac

Booster

AGS

RHIC

AGS and RHIC Experimental Areas

STAR

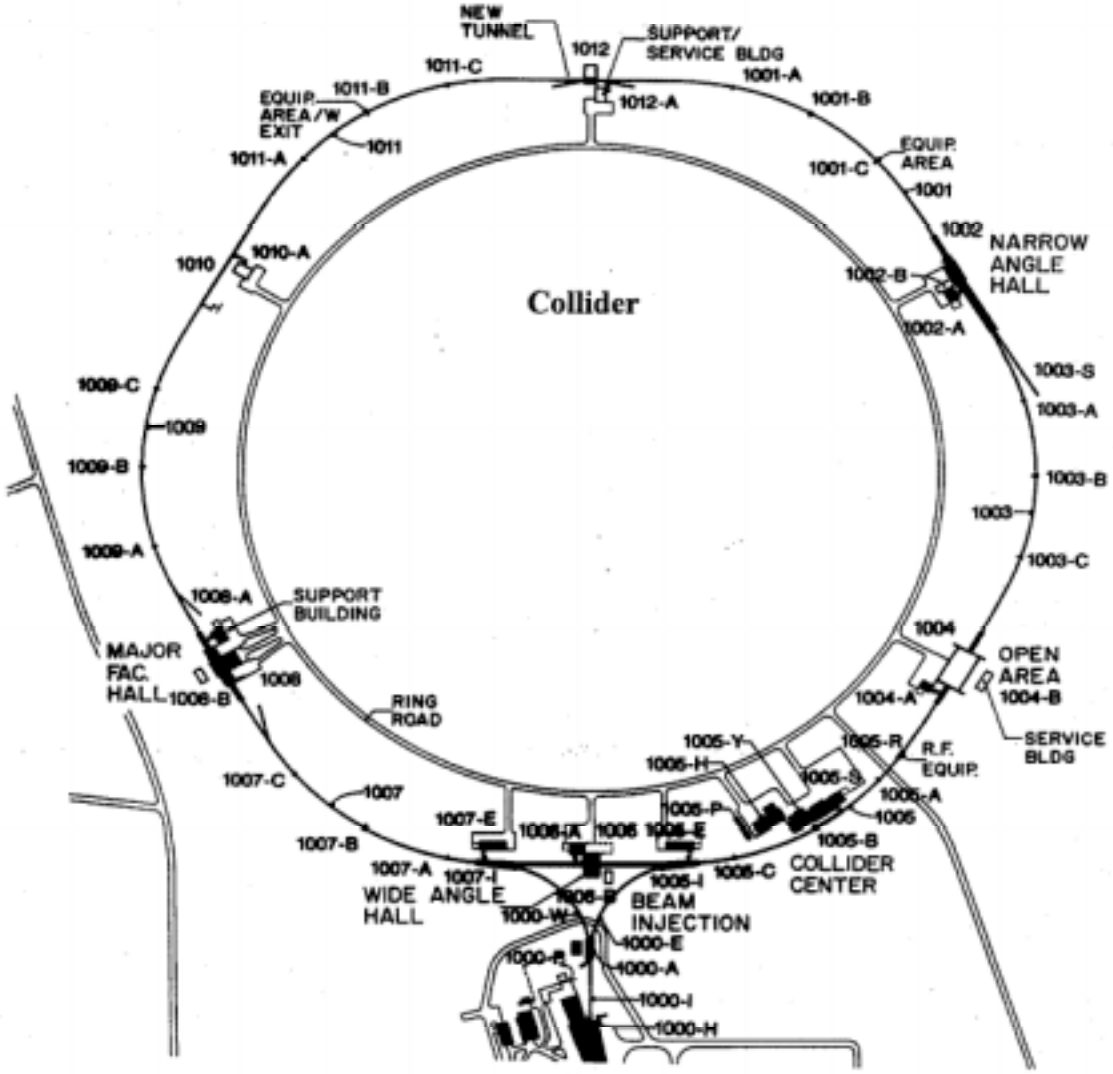
B912

PHENIX

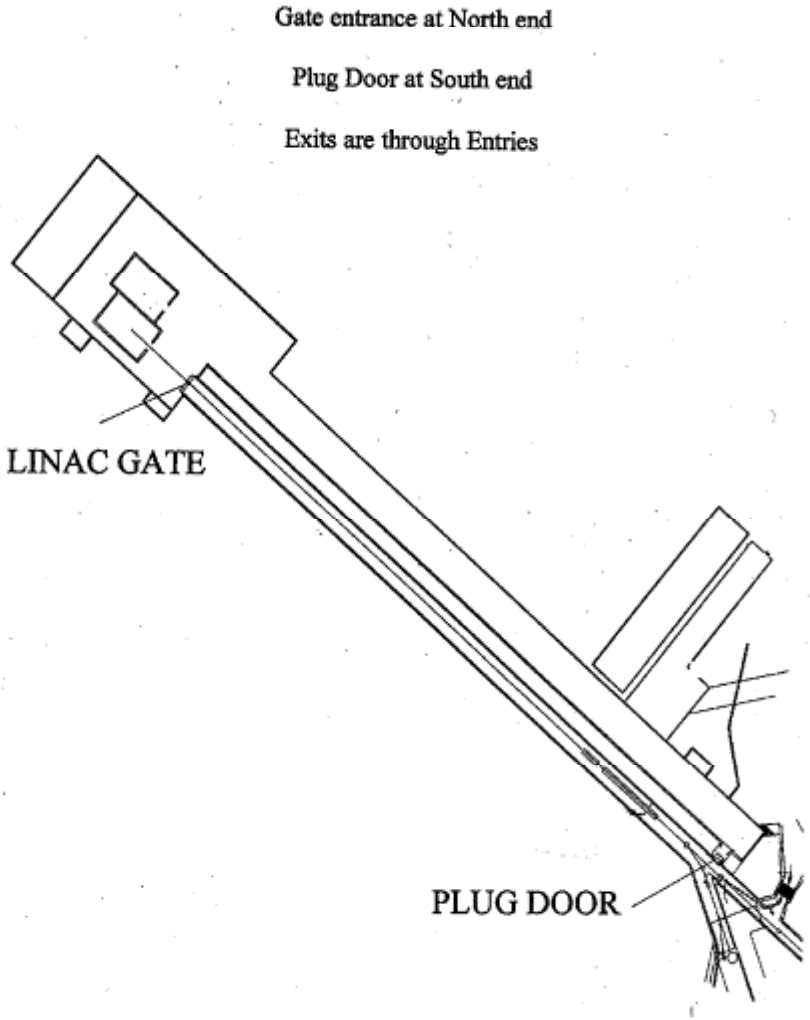
PHOBOS

BRAHMS

COLLIDER RING



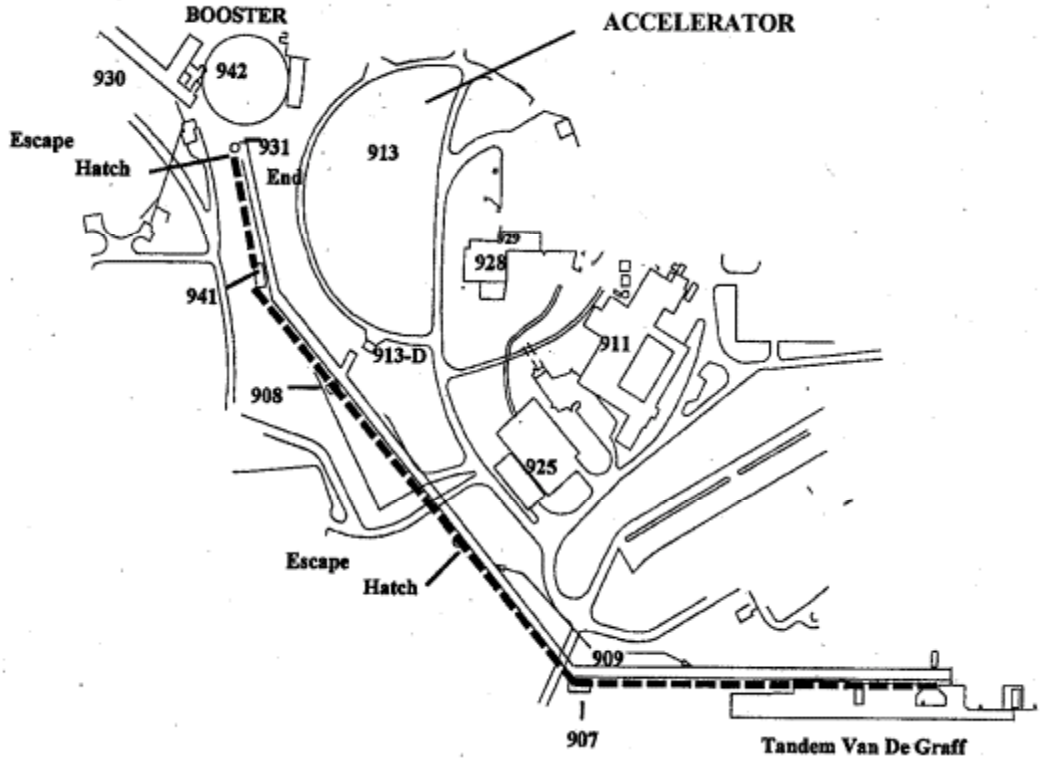
LINAC TUNNEL BUILDING 930 BASEMENT



TANDEM TO BOOSTER TUNNEL

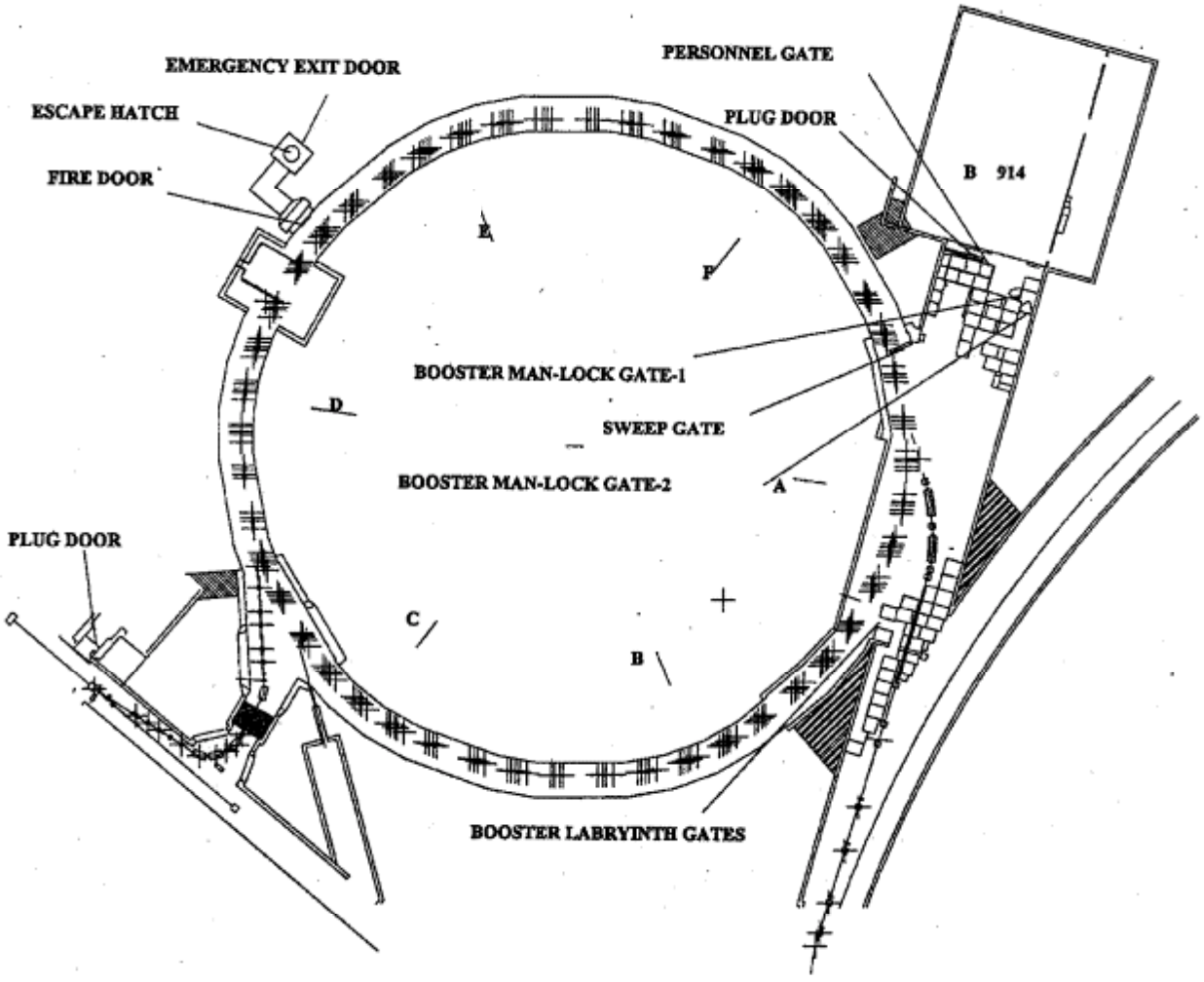
Entrance gates at Buildings 907, 908, 941
Obtain key from Tandem Operator
Exit through gates
Emergency exits through the escape hatch at Booster end of tunnel and between Buildings 907 and 908

TTB Line



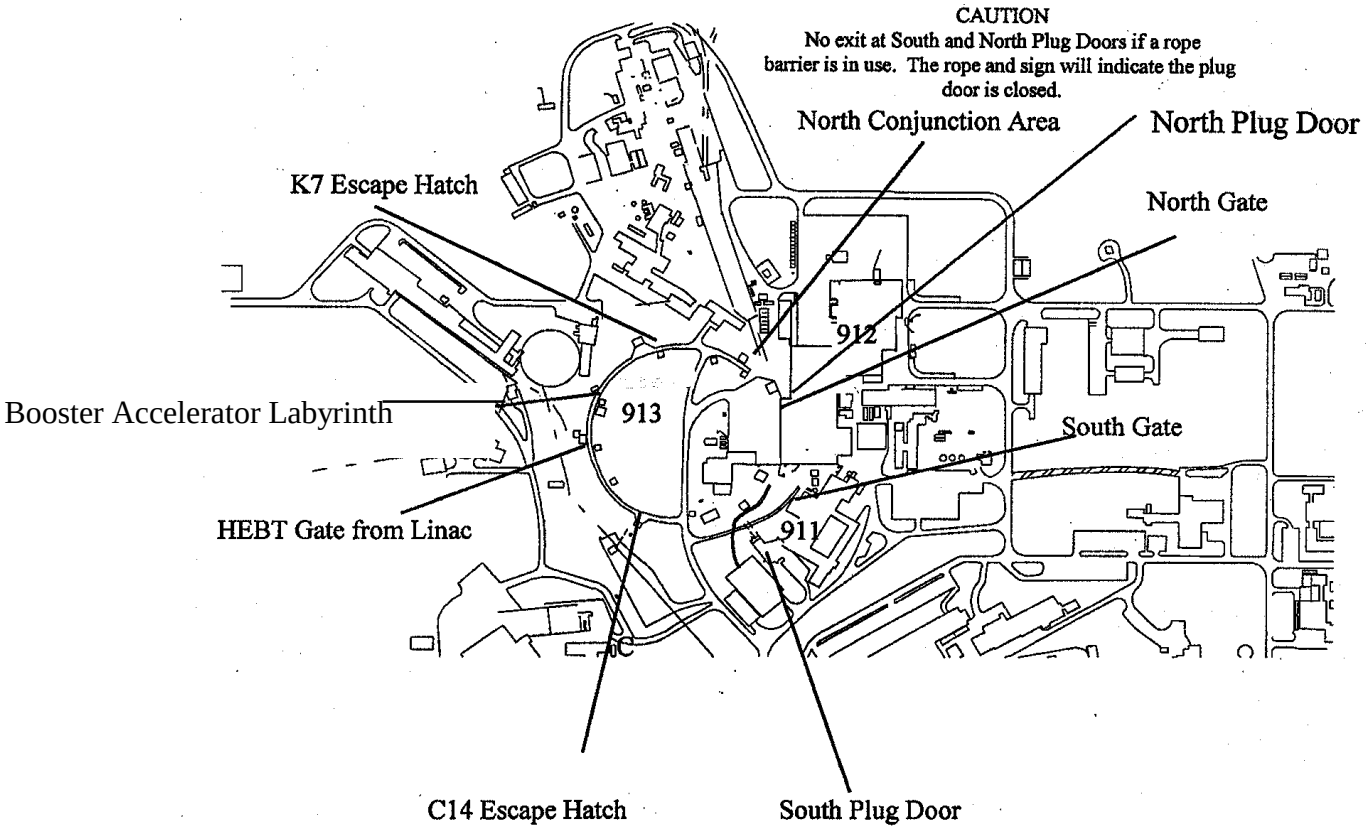
BOOSTER RING BUILDING 942

Gate Entrance from Building 914 (Also Emergency Exit)
Plug Door from Building 914 (Equipment Entrance)
Labyrinth from Accelerator Ring with Booster Off
Exits are through 914 Gate and Plug Door (When Plug is Open)
Escape Hatch for Emergencies ONLY, labyrinth is NOT an emergency exit.

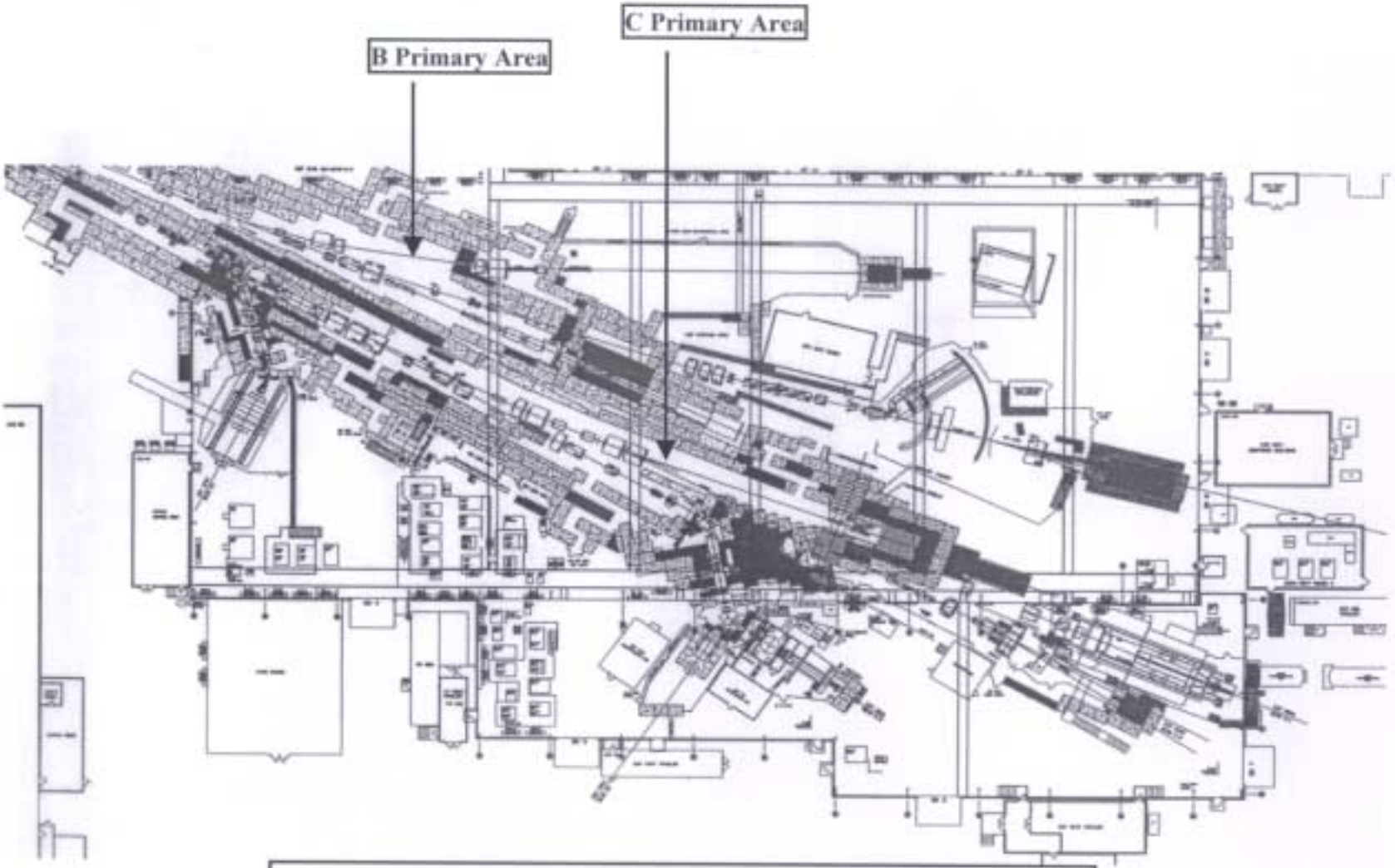


ACCELERATOR BUILDING 913

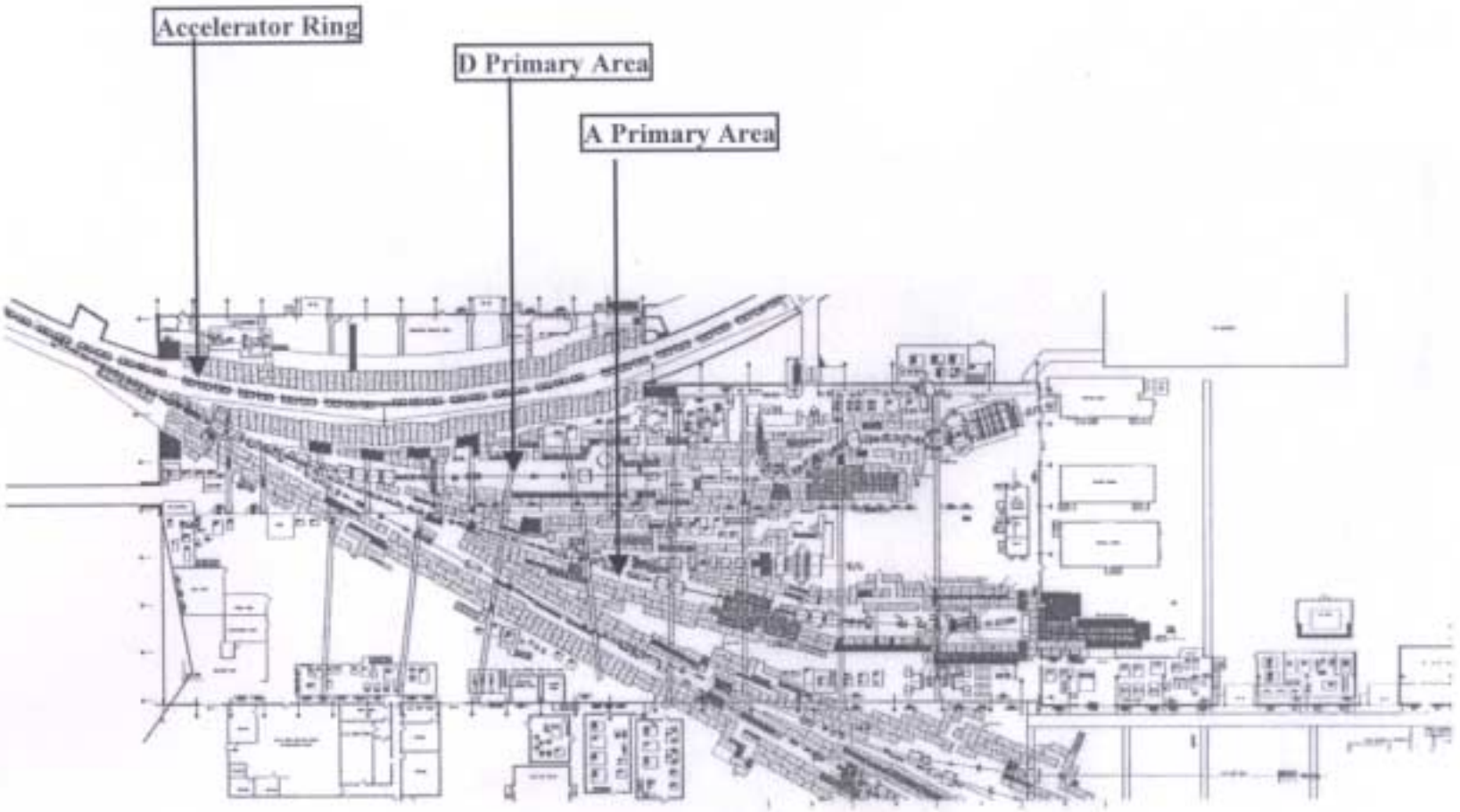
Entrances at South Gate from Building 911A
North Gate from building 912
North Conjunction Area near Building 919
South Plug Door near Building 911
HEBT Gate from LINAC Tunnel
Booster Accelerator Labyrinth



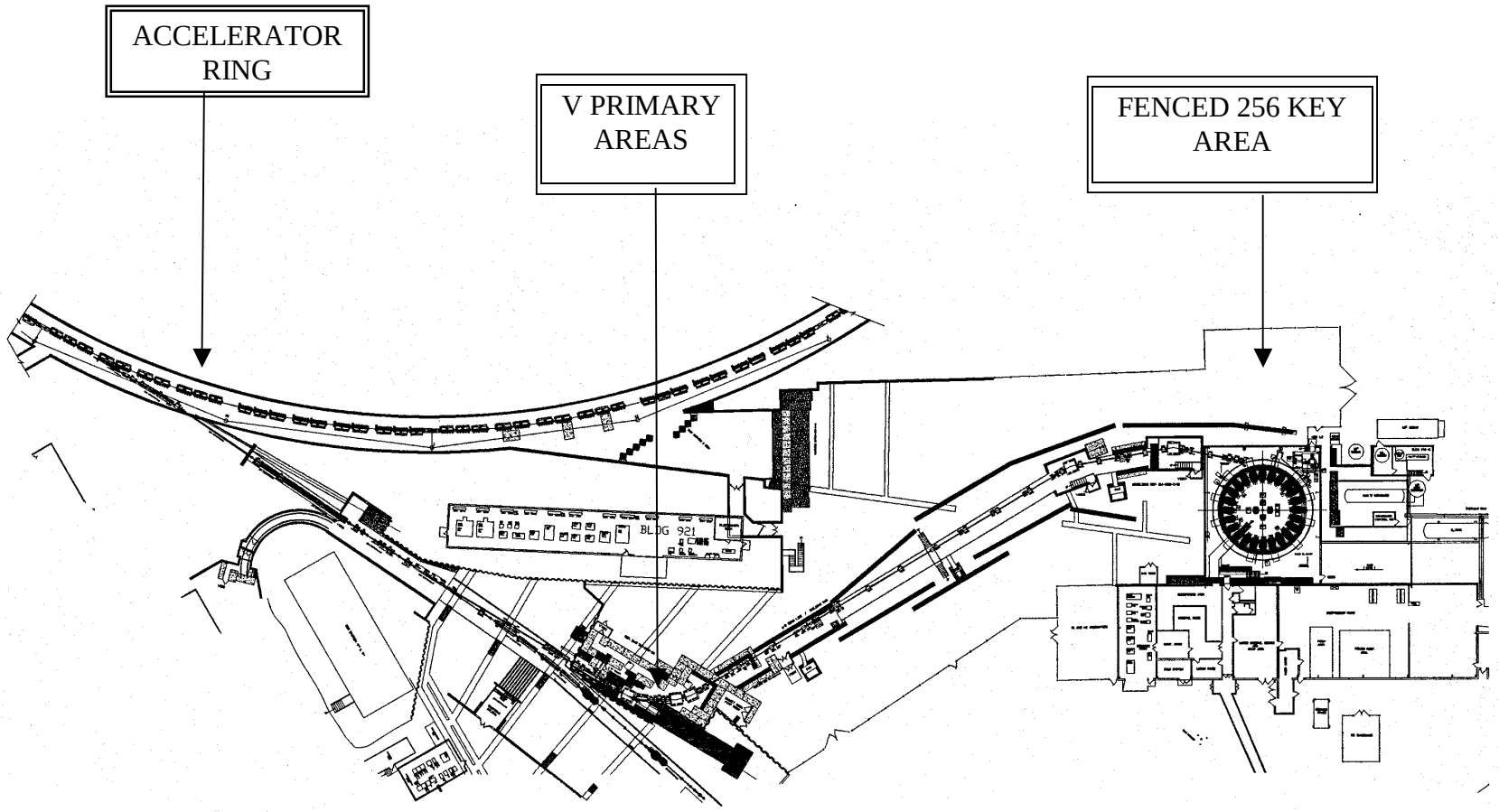
Exits at: Any gate during Restricted Access
The Gate you enter during Controlled Access
Emergency Exit at Escape Hatches C14 and K7
DO NOT use HEBT Gate or Booster Accelerator Labyrinth



SLOW EXTRACTED BEAM AREAS IN BUILDING 912

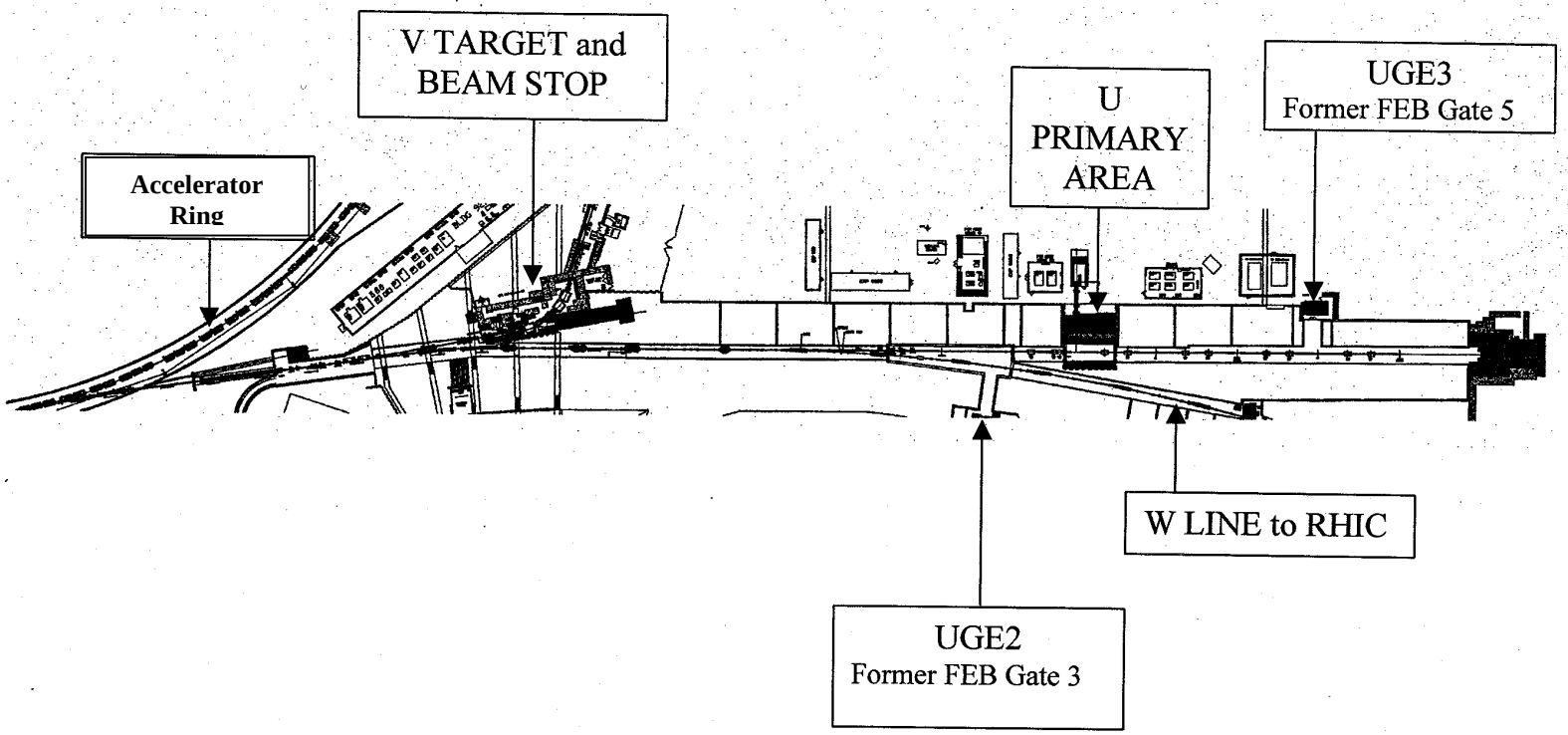


SLOW EXTRACTED BEAM AREA IN BUILDING 912

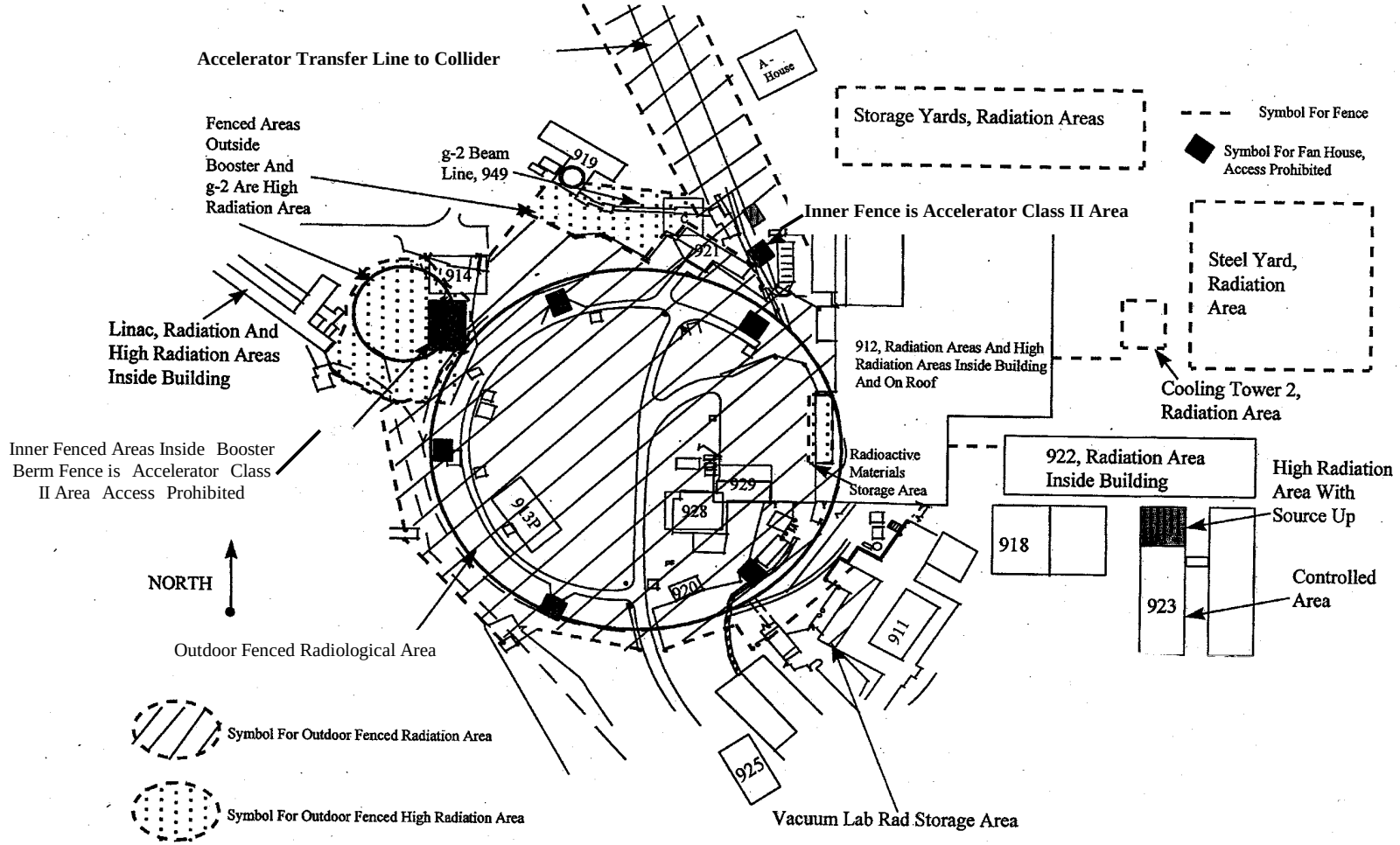


FAST EXTRACTED BEAM AREAS, g-2 EXPERIMENTAL AREA

BUILDING 927, ACCELERATOR to COLLIDER TRANSFER LINE



MOST AREAS AT ACCELERATOR THAT ARE POSTED DURING RUNNING



ENTRY MODES AND STATUS INDICATORS

A flow diagram shows the steps the C-A Department takes in going from the highest level of restriction to the lowest:

ACCESS PROHIBITED

↓

BEAM DISABLED

↓

CONTROLLED ACCESS DECLARED BY MCR

↓

HP SURVEY FIRST, THEN CONTROLLED ACCESS

↓

RESTRICTED ACCESS DECLARED BY MCR

↓

HP SURVEY FIRST, THEN RESTRICTED ACCESS

The PASS (Particle Accelerator Safety System) located within the Collider portion of the complex, and the Accelerator Access Control System are designed to control access to beam areas and detect excessive radiation levels outside shielding via radiation monitors (chipmunks). Additionally the PASS system detects Oxygen Deficiency Hazard (ODH) conditions and sets off alarms, turns on ventilation equipment and secures some electrical equipment. The major interface in the PASS and Access Control System consists of access gates through which entry is made possible through the use of access cards and keys. As with all Security Access

Entry and Exit Gate Boxes at the Collider

systems, Accelerator Access Control and PASS .
gate entries require ONE CARD/KEY ONE ACCESS ONLY! Multiple access (or tailgating) is considered a serious violation of procedures, and is subject to disciplinary action.

ENTRY and EXIT GATE BOXES
(Collider)

The entry and exit boxes at gate areas located at the Collider require the use of an Access Card and or CA Keys to enter. A system of lights on these boxes indicates the machine's operational access status.

GREEN LIGHT - RESTRICTED ACCESS, To enter place card on reader, get green light on reader, open door. To exit turn knob to open door.

YELLOW LIGHT - CONTROLLED ACCESS,
To enter, confirm accessibility with experimental shift leader . Get key from MCR supervisor. Telephone MCR (x4662) from access gate, be observed by video camera, a tone will sound when gate can be opened. To exit when yellow light is on, requires that MCR must be contacted (telephoned) and when buzzer is sounded you may open gate. If you do not contact the MCR prior to exiting, the PASS will crash. This will require the MCR to sweep the area and delay machine operation.

RED LIGHT – ACCESS PROHIBITED,
No access is allowed. Beam is already on or is imminent.

RADIATION HAZARDS

- PRIMARY BEAM: in-beam dose rates up to 10^{14} mrem/h from hadrons.
- SECONDARY BEAM: in-beam dose rates up to 10^{11} mrem/h from hadrons, and leptons.
- FAULTS: radiation penetrating through shielding from unplanned beam losses may lead to doses of several tens of mrem from neutron and gamma radiation near shielding or fences. Faults may last a few seconds before machines are interlocked off.
- NORMAL OPERATIONS:
    - ♦ About 1 to 2 mrem/h or less in continuously occupied areas from neutron, and gamma radiation that penetrates the shielding at the accelerators, and < 1 mrem/h at the Collider.
    - ♦ Accelerator cooling water lines are 100's mrem/h during running periods and for several minutes post shutdown (gamma).
    - ♦ Accelerator cooling water towers are up to 20 mrem/h at base of tower and this continues for several minutes post shutdown. Cooling water plumes are 0.01 mrem/h or less.
    - ♦ Air activation at the accelerators may reach 100's mrem/h from airborne radioactivity in target caves for several minutes post shutdown (beta, gamma).
    - ♦ Short-lived contamination (30 minutes) from air activation in primary beam lines. Up to 5000 dpm per 100 cm^2 of floor surface for several hours post shutdown (beta, gamma).
- RESIDUAL RADIATION AT ACCELERATORS:
    - ♦ Primary beam components are up to 10,000 mrem/h (gamma).
    - ♦ Targets are up to 50,000 mrem/h (gamma). V target may be 100,000 mrem/h or more immediately after shutdown.
    - ♦ Primary shield blocks inside target caves are 100's mrem/h (gamma).
    - ♦ Long-lived radioactivity created in soil near targets, beam stops, and beam scrapers (100's of mCi of tritium and ^{22}Na).

The principal accelerator radiation hazard associated with the C-A primary areas, is derived from the high-level residual-radiation. Exposure to this radiation results from working on or near activated machine components, beam stops, shield blocks, cooling water, activated soil, and activated air in the primary beam enclosures. Significant residual radiation is confined to

the accelerator portion of the complex. The Collider has residual radiation levels generally below 1 mrem/h or less.

Direct exposure to the beam is not possible if areas are entered in the correct way. However, exposure to radiation from unplanned beam losses in adjacent primary areas is possible. This may result from brief faults lasting a few seconds such as during a beam crash due to loss of a steering magnet power supply.

RADIATION LEVELS FOLLOWING HIGH-INTENSITY PROTON RUNNING

AREA	LOCATION	ROUTINE RADIATION LEVEL, mrem/h
Linac	BLIP Y	500 to 1000
	Booster Interface	500
Booster	Inside of Ring	10 to 200
	Outside	1 to 100
	Extraction Area	200 plus
Accelerator Ring	Inside of Ring	100 to 10,000
	Outside	1 to 1000
	Extraction Area	10,000
Collider*	Collider Tunnel	< 5
Switchyard and Beam Lines	Near Center of Magnet Gaps	10 to 10,000
Target Caves	Inner Gate	100 to 2000
	A-D Targets	50,000
	V Target One Week Post Shutdown	300,000

The approximate dose rates shown in the table are based on radiation surveys taken shortly after high-intensity proton operations.

* Collider dose rates are based upon operations consisting of heavy ion acceleration.

ENTERING, WORKING IN, AND LEAVING HIGH RADIATION AREAS

At the C-A, the Access Control or PASS (Particle Accelerator Safety System) systems are the major design features used for your radiation protection and it has two major states, Access Prohibited and Access Allowed. In the Access Prohibited state the machine is either operational or it is "cocked and ready to fire." Radiation hazards may be at their most extremes in this state and are lethal. Thus, no one is allowed.

To prevent entry, the electric key-strike (similar to a deadbolt) on each access gate is disabled from the Main Control Room, and gates will no longer work with a single access key or access card. If you force a gate open, sensors will detect the door's open position and cause at least two critical devices, such as beam stops, to intercept the beam before one can penetrate the area to any significant degree.

ACCESS PROHIBITED TO VERY HIGH RADIATION AREAS

The following is true whenever the primary areas are in the Access Prohibited State:

- All electric strikes on access-gate doors are disabled; thus, preventing entry.
- All access gates have a minimum of two sensors to detect an open door.
- Two critical devices will stop the beam if interlock occurs.

In the Access Control System , allowed state, two major sub-states have been defined, Restricted Access and Controlled Access, and each has a number of significant features and requirements that are described in detail on the following pages.

A flow diagram shows the steps the C-A Department takes in going from the highest level of restriction to the lowest:

ACCESS PROHIBITED

↓

BEAM DISABLED

↓

CONTROLLED ACCESS DECLARED BY MCR

↓

HP SURVEY FIRST, THEN CONTROLLED ACCESS

↓

RESTRICTED ACCESS DECLARED BY MCR

↓

HP SURVEY FIRST, THEN RESTRICTED ACCESS

ACCESS TO CONTAMINATION AND HIGH RADIATION AREAS

To provide Radiation Workers with a method to review tasks in High Radiation or Contamination Areas, and to assure that the personnel are cognizant of the prerequisites to enter such areas, a sign in form is used prior to entry. All Radiation Workers intending to enter such areas must complete the Contamination Area and High Radiation Area Sign-in Log. This log is designed to act as a checklist for entry requirement as well as Radiation Work Permit (RWP) sign-in sheet and digital dosimetery log. The list is located at entrances to primary areas along with a log of annual standing RWPs and Enhanced Work Permits.

ACCESS ALLOWED TO HIGH RADIATION AREAS

One of the following sub-states exist whenever the primary area is in the Access Allowed State:

- Controlled Access
- Restricted Access

Question: true or false? The primary means of ensuring that people are not in primary areas before turning on the beam is by conducting a manual sweep (visual inspection) of the areas before beam is enabled.

Answer: true. All primary areas (Linac, Booster, accelerator, AtR, and primary beam lines) are swept exclusively by Main Control Room Operators prior to going from the Restricted Access state to the Controlled Access state.

CONTROLLED ACCESS
(Accelerator)

- The conditions, requirements, hazards and restrictions that apply to Restricted Access apply to Controlled Access.
- While all systems have a barrier and most systems are turned off, only 5 to 7 electrical systems are locked out and tagged.
- A gate watch with C-A operators will be established at a single gate.
- Radiation Worker I and C-A Access Training are required for unescorted access.
- Access is accomplished by entering and exiting through this one and only gate.
- Entry requires simultaneous key release at the gate and at the MCR.

Under Controlled Access, only 5 to 7 electrical systems are locked out and tagged, although most electrical systems may be turned off. The 256-Key or 0-Key alone do not work. Access is achieved by entering or exiting through one designated gate, and by a sign-in / sign-out system. The sign-in sheet is intended to keep track of where individuals are located. You may also be asked to leave your BNL ID card or your Rad Worker 1 card (blue card) at the gate, which will be returned to you upon exit. The gate watch sign-in system is NOT a substitute for the High Radiation Area Log sheet, it is in addition to it.

Initial entry through the gate requires simultaneous key release by an Operator at the gate plus an Operator stationed in the Main Control Room.

A public address system announcement is made when going from Restricted Access to Controlled Access. If you are present in the area when going from Restricted Access to Controlled Access, you will be asked to leave. The area is then swept by Main Control Room Operators and you may then re-enter under Controlled Access conditions. Most high-power systems will be on or under test when you re-enter. Additional Public Address System announcements will be made regarding the status of equipment as it changes during Controlled Access.

When going from the Access Prohibited state to the Controlled Access State, the C-A RCTs must enter and survey primary areas for recent activation. Up to 10,000 mrem/hour from recently activated

components may be expected. Generally, at least a 15-minute delay is required before entering primary areas after a beam-off condition in order to allow short lived airborne radioactivity to decay. Entry may be further delayed many hours or many days if practical. This is done to reduce the radiation levels in a potential work environment to as low as reasonably achievable; these delay times take into account the shutdown or maintenance schedule and your anticipated radiation exposure.

Question: true or false? - Controlled Access means you must log in with an MCR operator and enter and exit through the same gate.

Answer: true. Operators must know where you are so they do not have to re-sweep the area.

RESTRICTED ACCESS
(Accelerator)

NOTE:
Entry is not controlled by a gate watch during Restricted Access. All who are issued a 256-Key or 0-Key may enter and exit at will.

- There is no beam.
- About 100 electrical systems are locked and tagged. This pertains only to Restricted Access.
- Radiation Worker 1 Training and C-A Access Training are required for unescorted entry.
- A 256-Key or 0-Key, TLD badge and a self reading digital dosimeter are required.
- You should be aware of your dose for the year-to-date.
- An alarming dosimeter is required when working near radiation fields greater than 100 mrem/hour. This feature is provided by most digital dosimeters.
- A Job Specific Radiation Work Permit is required if the area is a High Radiation Area.
- A Job Specific RWP is required if the area is a Radiation Area and you plan to receive more than 20 mrem.
- A Job Specific RWP is required if the area is a Radiation Area and the collective-dose for the job-crew exceeds 200 person-mrem.
- An ALARA Committee review is required if the collective dose for the job exceeds 750 person-mrem.
- A dose rate indicating device is needed for radiation levels greater than 1000 mrem/hour; e.g., chirping dosimeter.
- Access is not permitted for levels greater than 50,000 mrem/hour. Access requires special written procedures and approvals.
- Radiation survey by RCTs at onset of shutdown required.
- Contamination Worker Training may be required to enter certain beam-lines.
- Higher radiation spots from 100's to 1000's of mrem/hour may exist along the beam lines.
- X-rays from beam splitters, RF tanks, and high-voltage devices are possible whenever these systems are under test.
- Dispersible activated debris such as leaking pump oil and broken vermiculite bags may be present.
- High-voltage electrical hazards such as Wood's metal wiring, vacuum pumps, and security-system wiring will exist.
- Escorting of untrained persons is allowed ONLY if escorted by a qualified and pre-designated C-A staff member. A

Training Waver form is required for all escort situations.

- Each Radiation Worker must complete the Contamination Area and High Radiation Area Sign-in Log sheet for each job performed that day in such areas.
- Radiation Workers are required to complete the Self-Reading Digital Dosimeter portion of the log sheet after each job or once a day for mutiday jobs after exiting from a High Radiation Area or Contamination Area.

All persons meeting the training requirements are listed on an on-line database. In order to enter the Linac, Booster, accelerator ring and SEB primary areas you require a 256-Key. To enter U, V, V-target, V1, muon storage ring and upstream W tunnel, you need the 0-Key. Keys will be issued to you upon a request by your supervisor, or you may use a loaner key. All keys are issued from the C-A Training Office (A-128) after verification of training requirements. Loaner keys may be obtained from either the Training Office or the C-A Main Control Room.

Special care should be taken to prevent your clothing from becoming contaminated with activated pump oil, or loose activated debris in or near the target caves. Special care should be exercised when moving vermiculite bags that are used as fire stops in cable trays.

A person who has not had appropriate training may ONLY be escorted by designated people who are listed in C-A Permit G, located on the ESHQ Division web site. You may contact the C-A Associate Chair for Safety, x4250, or the C-A ESH&Q Division Head, x5272 to receive additional training to become a qualified C-A Escort.

Vacuum pumps remain powered and represent high-voltage electrical hazards. If you are working on a pump inside an accelerator, make sure you are at the correct location since many areas look identical. The Wood's metal system is always powered as is the access control system, and both are at 110 VAC. Some access controls system wiring is 24 V, but most is 110 V. Always assume the wiring in the access controls system is capable of delivering a serious electrical shock.

POWER FAILURE DURING ACCESS PROHIBITED MODE

From time to time, the battery back-up system for the access-control system fails during a power failure. If the backup system fails, then the access-controls system fail-safes, immediately inserts beam stops, and drops to the Restricted Access State. It will not remain in Access Prohibited or drop to Controlled Access since these states require power. If the areas have dropped to Restricted Access following a power failure, then there may be high levels of residual radiation in the primary areas. The RCTs would not have had the opportunity to do a survey. **Thus, DO NOT attempt to enter primary areas with your 256- or 0-key immediately following a power failure; CONTACT the MCR first.**

GATES ARE LOCKED AND EXIST FOR RADIATION PROTECTION

- The 256-Key and the 0-Key are the main keys that allow personnel to access C-A High Radiation Areas unescorted. NEVER let another person use your key or tailgate.
- You are the person most responsible for your safety. Use common sense. Never assume you know all the hazards.
- When in doubt, consult an expert. The Health Physics Office (x4660) can assist you in all your radiation problems and concerns.

The SOLE reason that the C-A Department has **locked** gates and other barriers at C-A is to prevent radiation accidents. The 256-Key or 0-Key are proof to the Operations Coordinator that you have had the appropriate training. You may be asked to show proof if you wish to enter certain C-A areas on Controlled Access. Persons who have had C-A Access Training but do not have a key may obtain a loaner key from the C-A Training Office, Room A-128. **The 256-Key and/or 0-Key will be recalled from persons whose training has expired.**

We know from national accident statistics that 10% of accidents result from unsafe conditions and that 90% result from unsafe acts. At C-A, our experience has also been that accidents and reportable occurrences are largely due to unsafe acts. We can and will continue to engineer hazards out of the C-A facilities. However, you are the person most responsible for your safety, and your attitude with regard to following the rules will always have the greatest impact on safety at C-A. This includes completing and maintaining your training current.

Question: what is the main purpose of the locked gates around the C-A?

Answer: to protect persons from radiation hazards.

Question: the 256-Key and 0-Key are the main keys to access High Radiation Areas associated with what facilities?

Answer: the C-A Department accelerators, the SEB and FEB primary beam-lines, and the C-A to Collider transfer line.

Question: are there any circumstances under which you may lend you're 256-Key or 0-Key to others or allow tailgating?

Answer: no. Only you may use your own key. You may not let any other person through the gate by holding it open unless you are a qualified C-A escort, or unless you are certain that the other person has all of the required training.

ARE ALL HIGH RADIATION AREAS POSTED?

Radiological Control Technicians do a good job at posting radiation signs. However, never assume posting is perfect. Posting can fall off. Posting can be missed or be inappropriate because radiation sources come and go. For example, there might be a temporary beam loss near a weak shield-wall, you might be working near "hot" water pipes, or a target might be temporarily removed from a shielded holder. However,

in most cases you will encounter near static radiation fields due to slowly decaying residual radiation from activated beam-line components. For the best measure of radiological conditions, consult with the FS representative (x4728)

All Primary Areas such as Rings, Switchyard, Transfer Lines, and Target Caves are posted as High Radiation Areas during shutdown or maintenance days. The radiation level may be greater than 100 mrem per hour in these areas, and up to 50,000 mrem per hour at SEB targets. Generally, there are not high levels of radiation all over the area; it is usually "hottest" at higher radiation spots such as the center of magnet gaps.

With regard to posting, the C-A Department experience has been that too many signs allow information to go unnoticed. This was the case during an reportable occurrence at the Linac. An area in the Linac had been changed over to a Contamination Area, and an additional sign was added to the door next to the original High Radiation Area sign. Both radiation signs had similar markings; however, the newer sign had the words "Contamination Area." This sign was overlooked and contamination was spread outside the area.

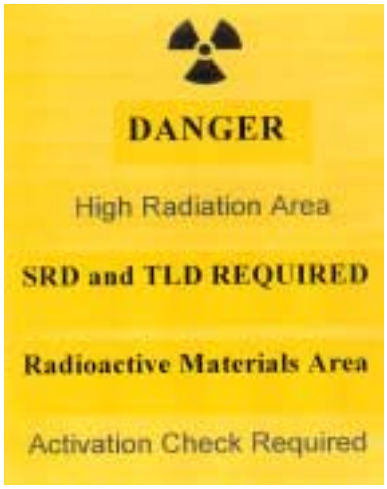
On the other hand, too few signs may not provide enough of an alert. This was the claim several years ago when a User jumped a radiation barrier in the experimental areas. The User claimed the sign that indicated "ONLY USE THE GATE FOR ENTRY" was not apparent to him although it was posted at two different locations on the barrier. **The bottom line is to always enter through a gate since this is where signs are always posted.**

Radiation survey maps are normally posted using maps at the entrances to rings and caves, and an appropriate number of measurements are normally indicated.

The C-A complex contains a variety of radiological areas. The most common are Radiation Area and High Radiation Area. These areas are posted with a variety of signs that must be read before entering. These signs must be obeyed as they indicate training requirements, TLD requirements and self-reading dosimeter requirements that must be met in order to enter properly. These areas are also separated by a variety of barriers including fences, shield blocks and building walls. **DO NOT CLIMB OR DEFEAT THESE BARRIERS.** Always access these areas according to the rules.

The C-A Department imposes additional fence and lock requirements near most primary targets. You may find that the areas close to targets require special procedures in order to put local shielding in place prior to entry. Your 256-Key or 0-Key will not open the special gates. Contact the E&FS Division Work/Maintenance Coordinator, x2046, for entry requirements.

REQUESTING A NEW SURVEY AND POSTING OF SIGNS



The above sign is typical at the entrance to C-A primary areas that are also High Radiation Areas. Signs listing radiological requirements are also posted at each entrance to each building at C-A.

Just after shutdown, the RCTs will survey the primary areas before anyone else enters. The RCTs may post HOT SPOTS at locations that are greater than 100 mrem/h and greater than 5 times the ambient levels.

Un-posted areas inside a Radiation or High Radiation Area are still radioactive but are at a lower level relative to HOT SPOTS. Request HP to do a survey if you plan to work in an un-posted area of an accelerator, beam line or target cave.

RADIOLOGICAL AREA DEFINITIONS

Controlled Area -- any area where access is controlled due to the presence of radiation above natural background levels or due to the presence of man-made radioactive materials. As a minimum, these areas are posted “Controlled Area.”

Radiation Area -- any accessible area where an individual may receive a whole-body dose greater than 5 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted “Radiation Area, TLD Badge Required.”

High Radiation Area -- any accessible area where an individual may receive a whole-body dose greater than 100 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted “Danger, High Radiation Area, RWP and TLD and SRDs Required.”

Very High Radiation Area -- any accessible area where an individual may receive a whole-body absorbed-dose greater than 500 Rad in one hour at 1 m (3 ft). These areas are not posted at C-A since they are not accessible.

RADIATION LEVELS, AREA NAMES, AND TRAINING REQUIRED		
Allowable Radiation Level	Area Name	Training Course(s) Required
< 5 mrem in one hour < 100 mrem in one year	Controlled Area	General Employee Radiological Training (GERT) *C-A Facility Specific Training
> 5 mrem in one hour < 100 mrem in one hour	Radiation Area	Rad Worker I Training *C-A Facility Specific Training
> 100 mrem in one hour	High Radiation Area	Rad Worker I *C-A Access Training

* Contact C-A Training Manager (x 7343) for specific training requirements

The accelerator complex has many Radiation Areas, and dose rates may be greater than 5 mrem in an hour. These areas are marked-off by ropes, fences or building walls. All entrances, every forty feet of fence or rope, and many Hot Spots are posted with Radiation Area signs. In order to work in or pass through Radiation Areas without an escort, you must complete Radiation Worker 1 training and C-A facility septic training.

In primary areas, the radiation level may be greater than 100 mrem per hour and up to 50,000 mrem per hour. In order to work in these areas, you must complete Radiation Worker 1 training plus C-A Access Training.

TRAINING SCHEDULE			
Course	Place	Time	Challenge Exam Option
Rad Worker I Training (RW I)	Bldg. 129 Training Room or Berkner Hall Consult w/ Training Coordinator (x7343)	Every Tuesday 9:00 a.m. to 3:00 p.m.	Contact Training Coordinator (x7343)
C-A Access Training with RW II Module	Contact Training Coordinator (x7343)	Scheduled as Needed	Contact Training Coordinator (x7343)

GOLDEN RULES FOR RADIOLOGICAL AREAS AT C-A

- Do not climb over or defeat barriers
- Do not ignore signs, labels, alarms or warning tags
- If in doubt – Ask for help

Question: true or false? The following may be ignored whenever you know the C-A is off: fences, barriers, signs, warning tags and alarms in radiological areas.

Answer: false. The C-A radiation protection program can only work if postings and barriers are obeyed at all times regardless of the status of the accelerators. Otherwise confusion occurs.

ACUTE RADIATION SYNDROME

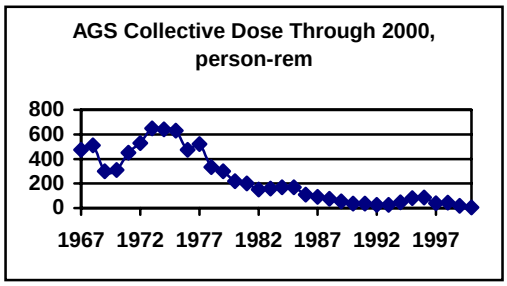
When describing the biological effects of very high, acute doses of radiation, it is the practice to use measuring units of Rad instead of rem. Animal studies used high doses of x-rays or gamma rays in a short period of time, and 1 Rad equaled 1 rem for these studies. The following will result from receiving a large dose over the whole-body in less than one day:

- 25 Rad - temporary blood changes that can be detected by a physician using appropriate instruments
- 150 to 200 Rad - observable symptoms such as diarrhea, vomiting, nausea, fatigue and hair loss
- 450 Rad - lethal dose to 50% of exposed population within 30 days if medical attention is not given to fight infections

C-A EXPOSURE PHILOSOPHY

Radiation Exposure At C-A Must:

- Have A Net Benefit
- Be As Low As Reasonably Achievable (ALARA)
- Be Within Limits



Annually, about $100,000,000 will be expended to operate accelerators for experiments at the C-A complex. Once an experiment is configured, invaluable scientific information is obtained. Estimates of the economic worth of this information are difficult to enumerate, but it is assumed that this research has a net benefit. Obvious things that do not have a net benefit are:

- Radioactive jewelry
- Eating, drinking or smoking in radiation areas

Eating, drinking or smoking in a Radiation Area or a High Radiation Area at the C-A is not permitted. Doing so would increase the time spent in the area and correspondingly the dose, without increasing the net benefit.

In addition, taking a shortcut through a Radiological Area in order to save time or to avoid inconvenience is not ordinarily an appropriate practice.

The collective dose, which is the sum of dose to all radiation workers at C-A, has declined in recent years. Based on experience, the annual collective dose for C-A staff approximately equals the product of 3 person-rem and the number of weeks of high-intensity proton operation.

The ALARA Committee consensus is that the majority of this collective dose comes from working on small short-duration jobs. The Committee wishes to capture all SRD dose for all jobs in all radiological areas. The Committee would like to determine which dose goes with which job. We wish to point out that your cooperation in entering self-reading dosimeter data each day will help define jobs where further dose reduction can be achieved and avoid a PAAA violation.

ALARA STRATEGIES

Basic ALARA strategy on the part of the worker revolves around effective use of time, distance and shielding. Time tends to have a linear impact on dose reduction, distance a quadratic impact, and shielding an exponential impact. ALARA may also be incorporated into design and operations. The following are examples of ALARA at C-A:

- Track and reduce unnecessary beam loss
- Design and add temporary shielding
- Hold discussions in areas where the radiation level is the lowest
- Use remote handling equipment
- Use portable power tools
- Plan work and practice
- Install quick disconnect and alignment features on beam-line components
- Install radiation resistant devices
- Assemble parts out of the area
- Identify lower dose rate areas
- Use mirrors and video cameras

In the past, the most dose-reduction has come by way of Accelerator Improvement Projects (AIP). We have improved the reliability of the vacuum system, the beam injection system, and the beam extraction system. Additionally, the Experimental Facilities and Support Division has designed radiation hardened magnets that can operate properly after very high doses. This has resulted in fewer repairs, which in turn reduces the dose burden because we are working less frequently on broken, activated equipment. Additionally, new accelerator systems have been installed to achieve better control of beams, which results in less activation of equipment.

Information on collective dose associated with specific jobs is fed back through the C-A ALARA Committee and C-A management. The C-A Department learns which jobs or experimental areas are associated with the highest dose. This in turn may lead to a future AIP.

Question: true or false? - ALARA applies to anywhere it is reasonably achievable to reduce radiation dose.

Answer: true.

Question: how is ALARA achieved?

Answer: ALARA is applied most effectively at the design stage. It is accomplished through planning, job proficiency, shielding, and ALARA committee review and past experiences of staff and users.

ADMINISTRATIVE DOSE LIMITS

Administrative dose limits are an integral part of the dose reduction scheme employed by the C-A Department. These limits are LESS than the dose limits set by DOE and Federal Regulations.

C-A ADMINISTRATIVE LIMITS FOR VISITORS, UNTRAINED STAFF, AND MINORS

Untrained visitor, untrained User or untrained staff has a dose limit of 25 mrem per year. A limit of 100 mrem per year is allowed with written permission from the Radiological Control Division and the C-A ESHQ Associate Chair for Safety

Minor (<18 years) dose limit is 25 mrem per year. Minors are not allowed to work in radiological areas but are allowed to visit or tour radiological areas.

C-A ADMINISTRATIVE LIMITS

Period of Interest	Maximum Individual Dose Limit, mrem	Individual Dose Limit With Line Authority Approvals, mrem
Calendar Year	1000	1000 to 1250 (C-A Chair Approval) 1250 to 2000 (Lab Director Approval)
Day	100	100 to 200 (Approval authority will be on the RWP)
Lifetime	N rem Where N Is Age of Person in Years	Laboratory Director Approval To Exceed N rem

The maximum daily dose to RWI-trained persons is 100 mrem. A first-line supervisor or experiment spokesperson may approve a dose between 100 and 200 mrem. The Radiological Control Division Representative must be notified that such an approval was given. The maximum calendar year dose is 1000 mrem. A formal approval must be obtained ***prior*** to going beyond 1000 mrem.

After a female RWI-trained person voluntarily notifies the C-A management in writing that she is pregnant, she is considered a declared-pregnant radiation-worker for the purpose of fetal and embryo radiation protection. The dose to the fetus during the gestation period is to be no greater than 350 mrem at a rate no greater

than 40 mrem per month. **Given that there is marginal sensitivity to detect low-level neutron dose, supervisors shall not employ declared-pregnant radiation-workers around beam lines during high-intensity proton operations.**

After a person voluntarily notifies the C-A management that she is pregnant, **she must follow-up and notify management in writing when she is no longer pregnant.**

Untrained Users, untrained staff or visitors are limited to no more than 25 mrem per year. Written permission must be obtained from the C-A ESHQ Associate Chair and the Radiological Control Division FS Representative to go beyond this; however, training in RWI is preferred. During the high-intensity proton run, the C-A management DOES NOT ALLOW untrained persons into the experimental areas since exceeding the 25-mrem limit is possible in one day.

The annual dose limit to minors and students under age 18 years is 25 mrem. A visitor badge may be issued to a minor who plans to visit or tour an C-A radiological area. Minors are not allowed to ***work*** in radiological areas.

The following are DOE dose limits as prescribed by law. The federal law is known as 10 CFR 835. These limits are similar to those set for other radiation workers such as those working at commercial nuclear power plants or at hospitals. Note that the BNL and C-A Administrative Limits are less than the legal limits.

ANNUAL DOE LIMITS

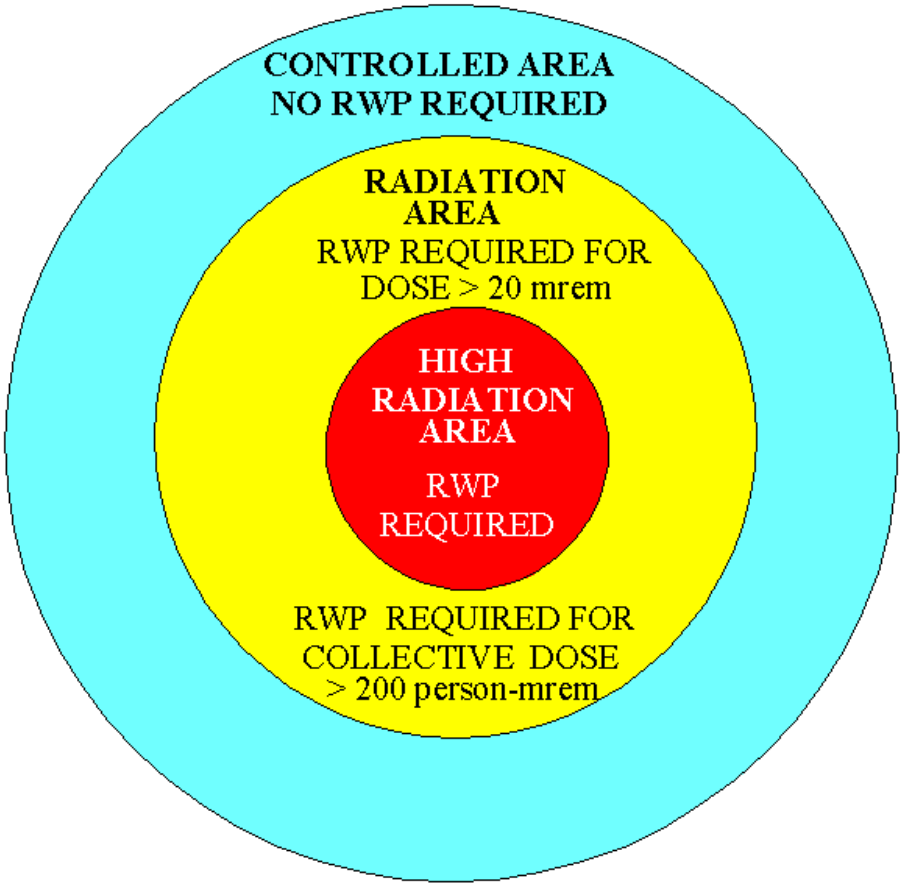
Dose of Interest	Annual Limit, mrem	Annual DOE Administrative Limit, mrem
Whole Body	5000	2000
Declared Pregnant Worker	500 in 10 months	-
Lens Of The Eye	15,000	-
Hands, Forearms, Feet, or Lower Legs	50,000	-
Any Individual Organ (Not Lens of Eye) Or Skin	50,000	-
Minors, Students, Untrained Visitors, and Public	100	-

RADIATION WORK PERMIT (RWP)

All personnel entering any radiological area at the Collider-Accelerator complex, must follow the requirements of the C-A Radiation Work Permits (RWPs) for work in or enter radiological areas. Attendance at this course is intended to make you familiar with these permits. Permits should be reviewed when you first enter the area. Job Specific RWPs are used to control operations or work in areas with changing radiological conditions.

- Radiation Work Permits apply to specific individuals for all jobs in High Radiation or Contamination Areas.
- All Jobs in a Radiation Area predicted to cause greater than 20 mrem to an individual shall require a job-specific RWP.
- All Jobs in a Radiation Area predicted to cause greater than 200 person-mrem to the work crew shall require a job-specific RWP.
- Persons must read and sign the RWP that they are aware of the requirements.

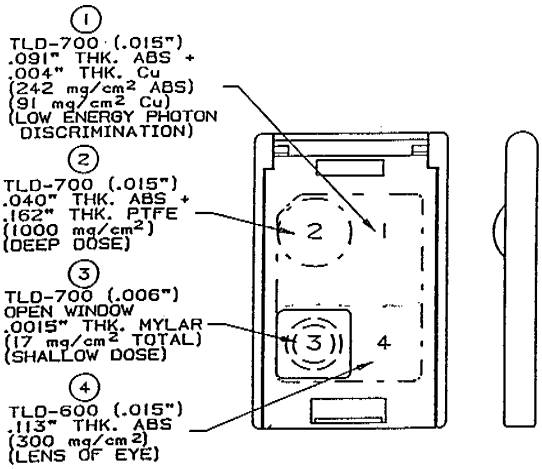
The following picture is a guide to the use of a Job-Specific RWP.

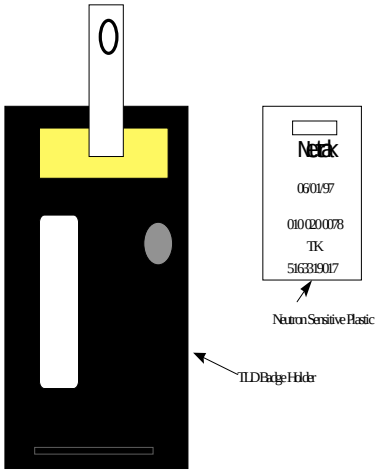


Question: you are planning to work in a High Radiation Area at C-A, and you know the job will result in dose to yourself and others involved. Who is responsible for determining if an RWP is needed?

Answer: the supervisor or lead person for the job is responsible. He must contact: 1) the C-A Radiological Control Coordinator (x2046 or x2189), and 2) the Radiological Control Division Representative (FS) (x4728).

TLD BADGE RULES





- Wear TLD badges on your torso and outside of your clothing.
- Return TLD badges to the TLD-badge board when not in use.
- Your badge may not look the same as those issued from C-A, but as long as it is from BNL, it is still OK.
- Wear TLD badges in Radiation Areas and High Radiation Areas as required by RWP.
- If you lose a badge, then notify the RCTs immediately.
- Return TLD badges before TLD-badge change day (first Saturday of each month).

TLD badges monitor exposures and verify the effectiveness of the C-A radiation protection program. TLD badges are read by BNL Radiological Control Division and routine monthly results are back after a few weeks.

TLD badges are changed the first Saturday of each month. Emergency TLD-badge read-out can be turned around in a day.

Two neutron sensitive plastics are added to the C-A TLD badge during high intensity proton running periods. These plastics are

processed by Landauer Corporation and they record neutron dose. The plastics more accurately interact with a broader spectrum of neutron energies, which is different from the TLDs.

TLDs 'see' >5 mrem per month, and plastic 'sees' >30 mrem per month. The accuracy is ± 20% for gamma and worse for neutrons. Do not expose the badge to heat, get it wet, take it home, wear it under your clothes or tamper with the TLD or plastic. Hang it up when you are not wearing it. The accuracy of the exposure data is dependent on proper care and use.

The Accelerator Experimental floor (building 912) requires that TLD badges must be worn at all times.

Shield tops and secondary areas on the experimental floor are labeled "High Radiation Area With Beam On," require self reading digital dosimeters in addition to TLD badges when the C-A is running. Rings, Transfer Lines and Caves are High Radiation Areas at all times when they are accessible, and you are required to wear both a TLD badge a self reading digital dosimeter for entry.

TLD BADGES FOR VISITORS

TLD BADGES FOR VISITORS

- Visitors Are Those Persons Who Are Visiting – They Are Not Expected To Work
- A Red-Stripe TLD Is Issued To Visitors For A Limited Period AND Cannot Be Re-Issued
- An Escort Is Required At All Times For Red-Stripe TLD Visitors

A visitor's badge is obtained from the C-A Training Office or from the RCT during off hours only if previous arrangements have been made with the C-A ESH&Q Division Head. In order to obtain non-escort status, attendance at Radiation Worker 1 and facility specific training, such as this course, is required.

A visitor TLD can be issued to untrained people with the approval of the C-A ESH&Q Division Head, and it is appropriate if the exposure is planned to be less than 25 mrem. A visitor with a red-stripe TLD is required to be escorted by a trained Radiation Worker at all times.

Question: two lighting contractors have just arrived from off site and you need them to bid on replacing the lights in the C-A Ring. What do you do?

Answer: contact the C-A ESH&Q Division Head *to help the visitors obtain red-stripe visitor TLDs from the C-A Training Office. Since the C-A Ring is a High Radiation Area, you must have them escorted by a*

designated Permit G escort rather than just a trained Radiation Worker. A list of designated escorts is maintained by C-A ESHQ Division (see web page).

In order to obtain a regular badge, successful completion of Radiation Worker (RW I) training is required. A regular TLD-badge is required in order to be allowed into Radiation Areas without an escort.

NOTE:

A special escort (Permit G) is required if an untrained visitor also wishes to enter a High Radiation Area.

SELF READING DOSIMETERS

Always:
- Log all measured dose.
- Wear on your torso outside of clothing.

Digital dosimeters are:
- Easy to read.
- Chirping function warns of dose rate.
- Alarming function warns of high dose rate.
- Required in order to enter or work in High Radiation Areas.

The purpose of self-reading dosimeters is to allow personnel to monitor their own exposure and compare it to the daily C-A Administrative Limit of 100 mrem. Self-reading dosimeters have ± 20% accuracy for gamma. They only respond to gammas. They are not calibrated to measure neutrons.

You should always:
Check the dosimeter before using it.
- Read it and zero it out before going into a High Radiation Area.

If the dosimeter shows an unexpected high or full-scale reading, then notify the RCTs (x4660). Your TLD badge should be read-out immediately.
A pencil dosimeter and a chirping electronic dosimeter are required to work in High Radiation Areas. Digital dosimeters have threshold alarms, which can be set to warn the wearer if he or she is approaching an Administrative Dose Limit.

Question: is it good practice to log the dosimeter reading each day on the dosimeter log sheet?

Answer: yes. This allows the supervisors to help ensure compliance with C-A Administrative Limits and is required by the BNL Radiological Control Manual and procedures.

Question: is an alarming dosimeter required whenever you work in radiation levels greater than 1000 mrem per hour?

Answer: yes, for working in the area, but it is not required when you are quickly traveling through one of these areas.

Dosimeter logs are distributed at primary gates, and collected each week. The dosimeter data is reviewed and by RCTs each week. Make sure you enter ALL your

exposure for the day into the dosimeter log. The C-A Safety Section will notify your supervisor if you are approaching a C-A Administrative Dose Limit.

CONTAMINATION

Contamination problems develop from time to time at the C-A; however, we have designed out target problems and air activation at this time. The past three years have seen the successful operation of high intensity targets. The C-A is also monitoring the target temperature, and the air near the target itself for airborne radioactivity. Contamination events from target failures seem to be under control. However, contamination from working with dispersible radioactivity is still possible if you are cutting or grinding an activated item or if, you encounter smoke or liquid spills in a primary area.

Radiation instruments are placed at target cave gates that are known to have modest levels of contamination. If you are not trained as a Contamination Worker, then you can not work in areas that are labeled "Contamination Area." However, you may be escorted by a trained Contamination Worker under certain circumstances.

Inadvertent skin or clothing contamination is a reportable DOE occurrence. The total number of reportable occurrences is a performance indicator that C-A must track as required by contract with DOE. We are obligated by contract to try to reduce the annual number of occurrences. Contamination incidents involving ingestion, inhalation, skin or street clothes are avoidable if you follow the rules that are posted in these areas.

It is C-A management's practice not to leave areas as "Contamination Areas." The C-A prefers to clean up the area if loose activated material is present. Working in a "Contamination Area" that is also a "High Radiation Area" may result in incurring undesirable levels of external exposure.

Currently:

- During high intensity proton running, there is measurable air activation near the target entrance gates. Within an hour after beam off, this contamination decays away.
- Some primary areas have measurable levels of moderate-lived (months) contamination on the floor. You may be required to wear protective covers over your shoes in order to enter these areas, and you will be required to take "Contamination Worker" training to work in these areas. The Radiological Control Division provides facility specific training for working in C-A contaminated areas.
- The BLIP spur in the Linac is considered to be a Contamination Area.
- Experience shows contamination may spread to beam-line components and even onto experimenters equipment in secondary areas.
- With the exception of a job entailing removal of a failed target, no C-A area has been found to have airborne contamination at a level requiring the use of respirators.

Some of this contamination is not easily detected. Allow the RCTs to make an accurate determination of the beta- and gamma-emitters that might be present prior to beginning a job in Contamination Areas. They have detection capability that can be

optimized to find the types of radioactive materials that might be present at C-A.

Gates, doors and access points have been plugged or covered with barriers to slow the spread of airborne contamination. During running periods, radiation postings are routinely updated by RCTs in order to define any new Contamination Areas.

All work where there is a potential for dispersible radioactivity must be reviewed by the Radiological Control Division Representative prior to the start of work. In addition, work involving dispersible radioactivity must be performed under a Radiation Work Permit.

Question: where does one expect contamination?

Answer: areas of high activation such as target caves. These areas have detectors located at entrance gates to allow for frisking.

CONTAMINATION CHECK REQUIREMENTS

- Use sensible work practices around greases, oils, broken block or rust, or in primary areas where you might repair damaged equipment that is covered with smoke or soot.
- If you are going to produce dispersible radioactive material, then the job requires an RWP.
- Check hands, feet, hair, and shoulders by moving the detector probe on the “frisker” at the rate of 1 cm/s.
- RCTs must check all items removed from the Contamination Area.
- Consult an RCT if there are any questions.

Waiting a brief period for decay after beam has been turned off, or wearing protective shoe covers and other types of protective clothing may be required. Step-off pads, protective clothing and frisker stations will appear at the entry and egress points to Contamination Areas. In addition, work in these areas requires a RWP, or written procedure approved by the RCD Manager..

ACTIVATED MATERIALS RULES

Labels For Shielding

- Large concrete and steel blocks: colored radiation symbols with the word "RADIOACTIVE" are painted on blocks and plates to indicate the maximum level of radiation 12 inches (30 cm) from any surface:

Green	< 5 mrem/h
Yellow	5 to 100 mrem/h
Red	>100 mrem/h

- Lead bricks, small concrete and steel blocks: the ends of these items are painted with the appropriate color.

- Some shield blocks may have Radiological Material Tags affixed (g-2 shield blocks).

Labels For Equipment

- A tag or label is placed on all radioactive equipment or hardware indicating its residual radiation level, the surveyor's name, and date.

At the C-A, you will encounter Radioactive Materials Areas that contain activated materials. For example, the C-A Ring, the primary caves, Buildings 912, 922, and 923, the steelyard, the block yard, and 965 fenced area. Radioactive materials that cannot be labeled are painted with the word "RADIOACTIVE" in a variety of colors to denote the radiation level. Red is greater than 100 mrem per hour, yellow is 5 to 100 mrem per hour and green is less than 5 mrem per hour. Please note that a grouping of radioactive materials tends to add to the total radiation level, which may be well above the level marked on a single item in the group.

ALARA dictates that personnel are aware of ambient radiation levels, but the C-A does not label all materials that enter the radioactive waste stream. Instead, we label the general radiation level from a pile of waste prior to packing it in waste bins. The Department tries to repair, remove or downgrade labels on activated items whenever appropriate.

Targets, flags, target holders, or any other objects that are exposed to primary beam become highly radioactive and are to be handled with special care in order to avoid excessive and unnecessary exposure.

ACTIVATION CHECK REQUIRED

- This posting means you **must not** release items from the area without checking for activation.
- Contact the HP Office to perform the activation check.
- Activation check has nothing to do with checking yourself for contamination.

In order to remove activated items from the C-A primary areas, a person must have an RCT do the Activation Check before removing the object from the primary area or from your control. Activated equipment must be properly checked and tagged before it is handled by others at BNL.

NOTE:

Only you can prevent unlabeled radioactive materials from leaving the primary areas. Ordinary items inside primary areas do not bear labels. They could find their way into offices, experimental-areas or waste streams unless you follow the rules.

Any shipments of material off-site must be checked in order to ensure proper packaging and labeling if it is radioactive. Off-site shipping of radioactive materials must be coordinated with the IS&M Group (x4051).

Question: you wish to remove equipment from a primary area to a Radiation Area where you will perform maintenance on it. What do you do?

Answer: call an RCT (x4660) to perform an activation check

Question: what does the posting "activation check required" mean?

Answer: upon exiting a primary cave, personnel must have a RCT check each piece of non-personal equipment that they remove from the cave for "activation." Do not confuse this with "contamination check required" which means each person must "frisk" his or her hands and feet to check for loose radioactive material and have a RCT check for dispersible radioactive material.

RADIOACTIVE MATERIAL AREAS

IF you did not bring it into a Radioactive Material Area and you want to bring it out, THEN you must have it checked for activation; e.g., tools you may find.

Many small radioactive parts may be generated inside Radioactive Materials Areas and they will not bear any labels, although the original assembled item may have a label. Only RCTs may release items from these areas.

RADIATION SOURCES

Beta, gamma and neutron sources produce radiation levels that may travel many feet in air. The radiation level drops rapidly as the inverse square of distance. This is because most sources are point-like objects. Sources may be stored in shielded containers. Many secondary areas have two or more source boxes since several different groups may employ the same beam-line in their studies. If you are using a source in your work, then the following rules apply even if you obtained the source from another BNL Department or Division:

- Contact the C-A Source Custodian (x5636) to have a source registered in the C-A inventory.

- Have all sources inventoried and leak-checked every six months by the C-A Health Physics Office (x4660).

- Complete the sealed-source inventory form and keep it with the source at all times.

- Notify Ball’s Isotopes And Special Materials Group prior to shipping a source to or from BNL (Contact the BNL IS&M Group at 516-344-5233).

- Contact the C-A source Custodian if you are going to remove a sealed source from the C-A facility.

If you are responsible for a sealed source, then DOE Orders and Federal Law require you to keep track of it in a way that can be audited by the Federal government. Additionally, you must be a trained and qualified "Source Custodian." Contact the C-A Source Custodian (x5636) for training. The Federal rules define sealed sources as

any radioactive item manufactured for the sole purpose of using the emitted radiation. A common example of a sealed source is an instrument calibration source. THE FOLLOWING ARE NOT SEALED SOURCES: smoke detectors, exit signs, activated beam-line components, activated shields, radioactive materials in-process such as targets or cooling waters, and keep-alive sources inside instruments.

If you are not sure about the definition of a sealed source, then contact an RCT (x4660) in order to make a determination regarding the rules.

Sealed Radioactive Source Inventory Form

1. SOURCE DESCRIPTION

BNL Identification: _____ Source Model: _____ Serial Number: _____
Radionuclide(s): _____ Manufacturer: _____
Radiation Type: _____ Chemical Form: _____ Physical Form: (solid) (liquid) (gas) (other)
Original Activity: _____ Date of Original Assay: ____/____/____
Physical Description: _____
Containment: _____ ☐ ANSI / Special Form
Radiation Reading _____ at Reference Distance: _____
Date of Receipt: ____/____/____ Purchase Order: _____

2. SOURCE STATUS

Status change (Check one or more): Date of Update: ____/____/____
☐ New source – initial entry ☐ Active – in use ☐ In storage
☐ New custodian ☐ Source integrity failed ☐ Lost
☐ Awaiting disposal ☐ Disposed
☐ Transferred to new location on-site (update section 4)
☐ Transfered off-site Destination: _____ Shipping No.: _____

3. SOURCE CUSTODIAN

Custodian's Name: _____ BNL Life/Guest Number: _____
Address: _____ Phone Number: _____ E-mail Address: _____

4. SOURCE LOCATION AND USE

_____ _____ _____
Department/Division Building Location (e.g., Room, Beam Line or Experiment)
Use: _____ Check If Installed In Device: ☐
Device Description: _____
Device Model: _____ Device Serial Number: _____

5. INITIAL INVENTORY / LEAK TEST

Initial Inventory/Leak Test performed: ☐YES ☐NO
(If Yes) Sealed Radioactive Source Accountability Form attached: ☐

Original to be sent to Master Source Custodian
Copy to be filed by Department Source Custodian

1.0/0a02e011.doc (02/2000)

RADIATION SAFETY LOCK OUT AND TAGOUT (RS LOTO)

Liaison Physicists, Liaison Engineers, and members of the Radiation Safety Committee must follow a specific C-A OPM procedure in order to lock out and tagout equipment or beam lines for radiation protection. Equipment or beam lines are generally locked out during barrier modifications or removals, or whenever the security system alone does not provide the required protection. This lockout is required in order to limit beam parameters such as polarity and intensity, or whenever a beam line is not authorized to operate. DO NOT alter or otherwise tamper with equipment that bears the RS LOTO tag.

SECURITY SYSTEM ORANGE TAGS

- Program disruption and/or electrical shock may occur by overlooking an orange warning tag.
- Tags and signs are often placed only on the front of equipment.
- Look at the front of equipment before starting work.

The devices sensed by the security system must remain correctly connected. In order to help ensure that personnel do not disconnect or alter these devices without following the approved procedure, the Access Controls Group has identified about 150 devices with an ORANGE WARNING TAG. Additionally, most of the Security System wiring is maintained at 120 VAC and it represents an electric-shock hazard.

In addition to an ORANGE WARNING TAG, equipment specialists document allowable work that may be performed on security-related equipment such as routine maintenance. Equipment specialists provide this information for each piece of equipment they connect to the Security System. The Access Controls Group makes these

informational documents available to all personnel who work on the equipment. C-A staff who work on equipment with an ORANGE WARNING TAG, must proceed by the guidelines in these informational documents.

In the experimental areas, these tags alert personnel that the device is critical to safe operation of the Security System. Scintillation detectors called NMCs (Nuclear Measurements Corporation) and chipmunk radiation monitors are part of the security system. DO NOT MOVE these devices since relocation will compromise their effectiveness.

Question: a power supply switch must be replaced and you want to disconnect all power to the supply. You encounter a circuit labeled with an Orange Tag and you want to disconnect it. What do you do?

Answer: follow instructions on the tag and get authorization to disconnect the circuit.

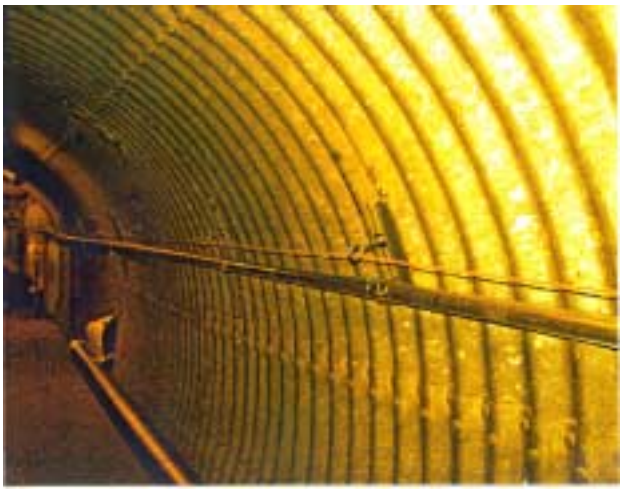
INTERLOCK BYPASS

- Do not take it upon yourself to bypass any interlocked system.

Interlock bypassing can only be done at the discretion of the C-A Radiation Safety Committee. Proper authorizations must be obtained prior to the bypass. The protection offered in lieu of the interlock must be equivalent. You can meet this requirement by having the liaison physicist and the Radiation Safety Committee Chair review and approve the bypass.

RESPONSE TO ABNORMAL RADIOLOGICAL CONDITION: CRASH BUTTONS / CRASH CORDS

Crash Button Located in Accelerator Ring



Crash Cord Located in U-Line

Crash Cord and Lights in the Collider

- IF the lights go out while you are in the AGS primary areas, THEN hit the crash button since beam is imminent. In addition to a visual warning, a PA announcement is used as an audible warning of imminent beam in primary areas at accelerator.
- In the U-V, V Target and upstream W lines, the lights DO NOT go out when beam is ready. INSTEAD an alarm will sound for 30 seconds and red-flashing strobe lights will illuminate the area.
- In the Collider tunnel and experimental areas prior to beam an orange strobe will illuminate the area and a warning alarm sounds for 90 seconds.
- Crash buttons are red and mushroom shaped. Doors have crash bars.
- Orange crash cords are mounted on the tunnel walls in the U-V, V Target and upstream W lines and Collider.
- IF you observe the visual warning, or hear the audible warning THEN you must start for the nearest crash button, or crash cord or start for the exit.
- If the lights go out, then do not assume it is a power failure, assume beam is imminent.
- DO NOT PANIC, you have time, 30 seconds minimum.
- Hitting crash buttons or opening doors will turn lights on.

Pressing crash buttons causes the beam stops to insert, lights to go on, and interrupts electrical energy to the main magnet bus and RF devices. Crash buttons are located on the inside and outside of accelerator and Booster Rings, at several locations in the muon storage ring area (g-2) of Building 919, and along the primary beam lines. There are also crash buttons located in several secondary beam lines. They are labeled with a red sign.
Orange crash cords are in use in the accelerator to Collider transfer line (AtR). Pulling a crash cord causes the beam stops to be inserted. One can always crash into or out of any primary area. Pushing the crash bar on primary gates in Building 912 does not do exactly the same thing as pushing a crash button or bar in the Rings; however, lights will go on and beam will be inhibited. After pushing a crash button, crash cord or crash bar, call the MCR and notify them where you are located.

DO NOT TAMPER with crash cords and crash buttons. Do not hang tools or clothing on the crash cords, this may stretch them out causing reset errors. Any modifications to the Security Access System (such as entry gates) must be pre-approved by the Security Access Group.

Question: if the light goes out in an accelerator primary area, should it be assumed that loss of electrical power occurred?

Answer: it should be assumed that the lights have dimmed in order to signal that lethal hazards are imminent. You should press the nearest crash button in order to turn the lights on and disable beam.

FLASHLIGHTS IN PRIMARY AREAS

Based on experience, power failures occur and primary areas become dark or poorly lighted even with emergency lighting. It has become standard practice to take a flashlight with you when work in primary areas, particularly when working in the accelerator Rings.

ABNORMAL RADIATION LEVEL

IF you encounter either of the following conditions:

- Radiation levels not anticipated on your RWP.
- Unexpected high self-reading digital dosimeter readings.

THEN stop work, alert your supervisor and contact an RCT (x4660) as soon as possible.

EMERGENCY DOSE FOR RESCUE OR RECOVERY

All persons must follow the instructions of the Department Emergency Coordinator (DEC) who is the Operations Coordinator during operations. During shutdown periods and maintenance periods, the C-A ESH&Q Division Head is the DEC. IF an emergency requires rescue of personnel and involves substantial risk, THEN volunteers may be selected based on their age, experience and prior dose history. These rescues are to be pre-planned activities and are not to be "heroic efforts to save a friend." The DOE and BNL emergency dose limits are:

- 10 rem for protecting major property where the lower dose limits of 5 rem is not practicable.
- 25 rem for life saving or protection of large populations where the lower dose limit is not practicable.
- 25 rem or greater is allowed only on a voluntary basis and only when a person is fully aware of the risks involved.

RED TAGS

Lockout/tagout (LOTO) is used everywhere at the Laboratory for personnel safety for energy sources. A LOTO is recognized by the presence of a red tag and a lock, and it requires that you obey specific OSHA requirements. In some cases, the equipment cannot be locked and only the red tag is used. In most cases, however, LOTO boots or other commercially available locking devices can be added to the device to enable complete LOTO. Contact the ES&H

Coordinator (x 7036, pager 6152 or x7200, pager 5605) or Artie Piper (x7934).

To prevent accidental radiation exposure, electrical shock or other hazards from different sources of energy, the LOTO shall only be removed by the individual who attached it. When the individual who attached the LOTO is not available, a committee of three employees must be formed, and the membership of the committee is designated by C-A OPM procedures. These persons will be familiar with the area or equipment under the LOTO and they shall determine if it is safe to remove the red tag and lock. Contact the MCR or the ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605) or Artie Piper (x7934), if you need to remove someone else's LOTO. A similar procedure is used for Radiation Safety (RS) LOTO.

All personnel who have to work on electrical circuits that were powered and are controlled by circuit breakers, disconnect switches and/or fuses must LOTO the circuits. OSHA, BNL and C-A require that all workers performing these tasks be trained in LOTO. If you or your co-workers fall into this category, then contact the C-A Training Manager (x7343) for training.

Question: a red tag is on a piece of equipment. You need to operate the equipment, what do you do?

Answer: contact the C-A ES&H Coordinator or MCR and ask for assistance.

CHIPMUNKS AND RADIATION SURVEYS

Radiation monitors - Chipmunks

During a running period, radiation surveys are updated daily, and continuous area monitoring is performed by instruments, called Chipmunks, which alarm in the Main Control Room. In addition, during running periods, daily radiation surveys of the experimental floor are made by RCTs. During shutdowns, surveys are done

initially, and whenever an RWP is used. Records of the surveys are maintained by the C-A Health Physics Office. Survey data is normally attached to the RWPs and copies are maintained at the job site.

Chipmunk readings are also recorded continuously and maintained in a database for later retrieval and review. Chipmunks are capable of alarming locally and are stationed at fixed locations in order to monitor high occupancy areas and other areas of interest.

Retrospective exposure rates for any area of interest can be determined by the staff at the C-A Health Physics Office.

The Chipmunk is set up like a street light with red, yellow and green indicators. A chipmunk will display a red blinking light for radiation levels greater than 20 mrem/h, and a yellow blinking light for levels greater than 2 mrem/hr.

There are approximately 100 chipmunk-monitoring devices in use at this time. They have pre-designated alarm levels established by the Radiation Safety Committee. Main Control Room Operators are trained to respond to alarms and investigate the cause, even if it means interrupting the physics program. Drawings that show chipmunk locations are posted on the C-A ESHQ web site.

RADIATION SAFETY SERVICES

- Contact Health Physics Office.
- Pager 6189 (Digital Pager).
- Telephone 4660.

The Radiological Control Division provides the C-A with services that encompass several operational aspects of safety including radiation safety. They provide dose records, radiation surveys, RCT coverage for high-dose jobs, and review of RWPs for ALARA. They also assist in re-setting secondary beam lines, and assist in interpreting abnormal radiation levels.

During running periods, RCT coverage is provided on all shifts. During shutdown, services are provided from 8:30 a.m. to 4:30 p.m., Monday through Friday. Assistance is obtained by contacting the Health Physics Office (x4660), or pocket pager 6189 (digital pager), or by contacting the C-A MCR (x4662).

Special shifts for RCTs may be pre-assigned allowing for specific round-the-clock coverage when needed during a shutdown. A few weeks advance notice should be sent to the Radiological Control Division Representative (x4728) for special RCT coverage.

ELECTRICAL SAFETY IN PRIMARY AREAS

Token box located at AGS South Gate

The electrical equipment in the primary areas covers a wide spectrum of voltage and current. In order to meet the requirements of OSHA 1910.146 and BNL rules, a lockout / tagout plan was developed for all workers who enter C-A primary areas.

Before any worker enters the C-A or Booster rings, the Main Control Room Operators must lock out about one hundred electrical devices. This procedure is called a Group LOTO. Operators will capture all the appropriate keys under this procedure and lock them in a box in the MCR. The key for this box is called the TOKEN. The TOKEN is placed in a box at the C-A South Gate and/or at the Booster plug door as appropriate. This box is called the TOKEN BOX.

A single senior individual at C-A is responsible for the TOKEN BOX, and they will be the first to place a lock and electrical safety red-tag on the TOKEN BOX and the last to remove it. After his LOTO is placed on the TOKEN BOX, EACH WORKER entering a ring MAY BE required to place THEIR OWN LOCK AND TAG on the box as well. The need for locking and/or tagging the box by each entrant DEPENDS ON THE WORK they are to perform. Walk-through of the areas where beam line equipment is not handled does not require a Radiation Worker to add their own lock and/or tag to the Token Box.

The C-A Operations Procedure Manual has procedures that define these requirements in detail. The execution of a Group LOTO for a ring will secure the equipment that the C-A believes to represent potential electrical hazards to personnel entering the ring.

As indicated previously, you MAY BE required to add your lock to the TOKEN BOX. For example, if you intend to work on the magnets or behind them, then you must place your lock and tag on the TOKEN BOX.

If you intend to work on a specific piece of equipment that is connected to its power supply; that is, cables are still connected to the device, then you must LOTO the specific power supply for that device. If you are not sure about your specific LOTO requirements, then please contact the C-A ES&H Coordinator (x7036, pager 6152 or x7200 pager 5605) or Artie Piper (x7934).

If you enter the ring when certain equipment has been left on for testing purposes, then you MUST have additional training. There may be specific C-A procedures written for this type of work. You would be notified by the OC or the responsible Project Engineer under these circumstances.

ELECTRICAL SAFETY TRAINING

If you work on electrical circuits that are powered through circuit breakers, disconnect switches and / or fuses, then you must LOTO the circuits before the start of work. OSHA, BNL and C-A require that all workers performing these tasks be trained.

The C-A has three courses covering electrical safety that you may be required to take and pass:

- Electrical Safety,
- Lockout / Tagout and
- Working Hot.

Lockout / Tagout and Working Hot training are required if you plan to work with:

- AC voltages greater than 50 Vac,
- DC voltages greater than or equal to 50 Vdc,
- Systems with greater than 10 ma of available current, or
- Systems that are capable of releasing 10 joules or more of energy instantaneously.

If you have questions regarding the electrical safety training requirement for your specific situation, then please contact the C-A ESH&Q Division Head (x5272, page 4820).

C-A CONDUCT OF OPERATIONS

- During C-A operations, contact the C-A Operations Coordinator located at the MCR (x4662) in building 911, regarding any problem; he can make all the necessary notifications or arrange for assistance.

- You can determine if the C-A is operational or shutdown by reading this information from TV monitors located throughout the C-A Complex.

- During maintenance periods, all scheduled operational related maintenance must be done with the authorization of the appropriate Divisional Maintenance Work Coordinator.

All C-A operations must have the appropriate authorization where required. Required authorizations are listed in the C-A Operations Procedure Manual. Lead-personnel are appropriately trained. If requested, you must satisfy C-A requirements for authorization (e.g., working on a system declared as "critical"). Responsibility for the safe and reliable operation of the Collider-Accelerator complex resides with the on-duty Operations Coordinator. The Operations Coordinator is the shift supervisor for the operating personnel and the focus for all operations related questions.

The Collider-Accelerator complex is made up of a number of facilities. They are the Tandem Van De Graaff, the Linac, the accelerator ring, the main magnet power supply, the A, B, C, D, U, and V beam lines, the Tandem to
Booster Line (TTB), the Booster, Collider Systems, the Accelerator to Collider transfer Line and the secondary-beam experimental area. During operations, all operations,

safety, or schedule problems in any of these areas should be reported to the Operations Coordinator first.

During maintenance periods, all scheduled operational related maintenance for the Collider-Accelerator complex would be performed following the notification of the Collider-Accelerator Department Maintenance Work Coordinator.

During a shutdown period, all problems are to be reported via the existing supervisory staff for C-A as appropriate. In the case of C-A personnel, all problems should be reported to your supervisor and the C-A ESH&Q Division Head (x5272, page 4820) if the problem involves training, safety or environmental releases.

BNL MANAGEMENT SYSTEMS

Brookhaven National Laboratory has put into practice a series of management systems to help ensure that work is done in a safe and environmentally conscientious manner. These management systems detail the processes and procedures that are associated with different types of work and are available to everyone via the BNL Standard Based Management Systems (SBMS) internet web site. SBMS is BNL's method for implementing the Integrated Safety Management System (ISM). ISM combines Environmental, Safety and Health requirements into the process for planning and conducting work here at the laboratory. Physical work activities are governed by the Work Planning Process.

GREEN WORK PERMIT AND IN-HOUSE WORK PLANNING AND SCREENING AT C-A

All internally initiated jobs at C-A must be screened for ES&H hazards. Green Work Permits are required for all moderate and high hazard jobs. The hazard levels for C-A work planners who are involved in screening are described as follows:

Low-Hazard Work is work requiring the attention of the worker to prevent minor injury. Failure to correctly perform low-hazard work would not damage equipment or structures or release potentially hazardous materials to the environment, except as a result of gross negligence.

Moderate-Hazard Work: Work requiring coordinated actions to prevent any injury to personnel, minor damage to equipment or structures, or release of hazardous materials to the on-site environment.

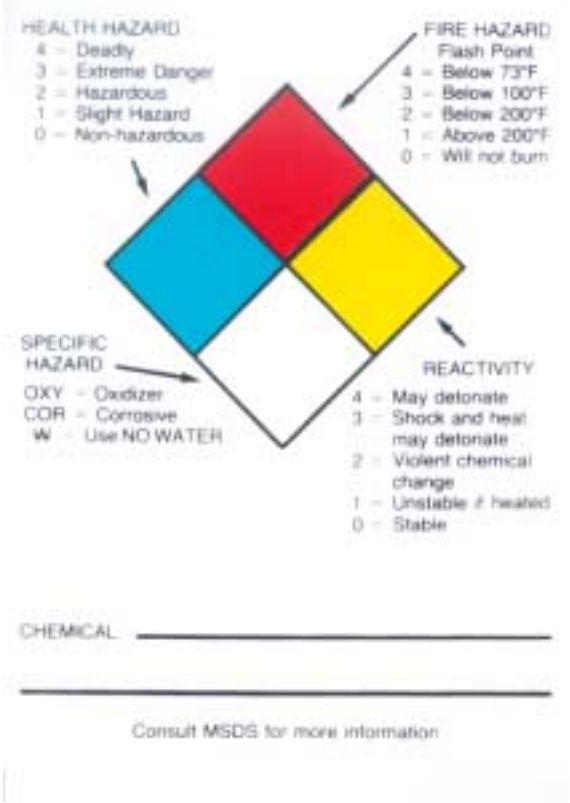
High-Hazard Work: Work requiring coordinated actions to prevent serious injury to personnel, significant damage to equipment or structures, or releases of reportable quantities of potentially hazardous materials to the off-sight environment.

Additional details and specific requirements for work planning are found in C-A OPM 2.28, Enhanced Work Planning." It is a supervisor's responsibility to ensure that all work is planned in accord with the intent of C-A procedures.

INFORMATION ON HAZARDS, YOUR RIGHT TO KNOW .

You have the right to know about potential health and safety hazards in your workplace, whenever the potential for exposure to hazardous materials exists. You will be provided with specific safety and health information by the ES&H Coordinator. Contact the ES&H Coordinator at (x7200, page 5605). The Coordinator can provide you with information on the Laboratory's policy on hazardous information, how to obtain Material Safety Data Sheets (MSDS) and interpret them. Some of the information that can be found on an MSDS is the name of the chemical, manufacturer, hazardous ingredients, physical characteristics, fire and explosion hazard data, reactivity data, health hazard data, precautions for safe handling and safety control measures.

National Fire Protection Association (NFPA) diamonds appear on various materials containing structures and containers to the degree of hazard for these materials.



The ES&H Coordinator can also provide information on how to select and use protective equipment, and explain the labeling system used on chemical containers.

CHEMICAL SAFETY

For your safety, purchased chemicals are inventoried by the Laboratory prior to delivery for end use. If you bring un-inventoried chemicals on site contact the ES&H Coordinator (x 7036, pager 6152 or x7200, pager

5605) to have these chemicals inventoried and bar coded prior to use.

STOP WORK - IMMINENT DANGER PROCEDURES

This procedure provides a policy and process to stop work at BNL to mitigate *imminent danger* to personnel, equipment or the environment. *Imminent danger* exists when there is a hazard that could result in death, serious injury, environmental impairment or significant damage, and when immediate action is required. The person issuing the stop-work order makes determination of the need for immediate action.

Anyone who will be given unescorted status at C-A must first be trained in this procedure. Only persons trained in this procedure have stop-work authority. For example, casual visitors to BNL and other untrained individuals do not have this stop-work authority. Persons who are not trained for unescorted access are still expected to call attention to any questionable or unsafe act or condition. C-A management shall take such notification seriously and make an evaluation.

C-A managers and supervisors are not allowed to start hazardous work unless the involved worker(s) are trained and qualified in this stop-work procedure.

Persons are responsible for and expected to issue a Stop-Work order for *imminent danger* whenever it is observed. If an employee is reassigned to work for another supervisor for a period of time, the new supervisor must ensure facility specific stop-work training is conducted prior to allowing work to commence.

This procedure is used to stop work when conditions that are interpreted to constitute imminent danger occurs. Other procedures shall be used to prevent people from taking unnecessary risks with lesser hazards or for stopping radiological work.

Any person who reasonably concludes that an *imminent danger* exists and that immediate action is required to mitigate the danger is obliged to take action to stop work. An *imminent danger* exists if proceeding with work could result in death, serious injury, or significant unexpected environmental or equipment damage. A person who concludes that an *imminent danger* exists must consider whether stopping work immediately or proceeding to a safe stopping point constitutes the greater danger.

Procedure

1. The initiator of a Stop-Work order for *imminent danger* shall state the following:
   "Stop work! You are in imminent danger because…"
2. Any person receiving a Stop-Work order shall stop work immediately, if that can be done safely, or at the first opportunity to stop safely.
3. The person issuing a Stop-Work order MUST NOT verbally or physically interfere, whether or not the recipients of the Stop-Work order continue to work.
4. After the work is stopped, the recipient of the Stop-Work order shall notify his/her supervisor and his/her ES&H Coordinator that a Stop-Work order was issued, and of the nature of the *imminent danger* that exists.

The person initiating a Stop-Work order shall identify him/herself to the affected workers as soon as it is safe to do so. In turn, the supervisor of the involved work shall notify his departmental management.

If the person issuing the Stop-Work order feels that the recipient(s) of the order failed to take appropriate action, then the initiator of the Stop-Work order shall notify his/her own supervisor and the C-A ESH&Q Division Head (x5272, pager 4820). If more than one Department is affected by the Stop-Work order, then the person initiating the Stop-Work order shall notify the C-A ESH&Q Division Head and the ES&H Coordinator of the other Department.

The supervisor and the ES&H Coordinator shall investigate and evaluate the need for further action or internal or external reporting. Management shall resolve appropriate issues in cases where the recipient of a stop-work order is not compliant with this procedure. There will be no reprisals by anyone for issuance of a stop-work order.

Following a stop-work order, the *C-A Department Chair* or designate shall determine, with advice and counsel from the ESH&Q Directorate, the conditions that must be met before work may resume. Input into conditions for restart shall also be sought from the person who initiated the stop-work. Work shall not be resumed until appropriate corrective actions and safety reviews are completed and the responsible manager authorizes restart.

RADIOLOGICAL STOP WORK PROCEDURE

This procedure provides a mechanism for trained Laboratory employees, guests, and contractors to stop radiological work that does not meet Laboratory requirements or creates the threat of radiological exposures or releases. This radiological stop-work procedure utilizes the requirements and processes established in the imminent hazard procedure, except that different criterion is described for the conditions under which a radiological stop-work order may be given. Because of the nature of radiological work, stop-work criteria are provided for certain situations that would not be considered "Imminent Hazard."

Improvement of radiological performance is a high priority at BNL. All workers trained in the radiological stop-work procedure have the responsibility to improve performance by providing careful attention to his/her performance and to that of co-workers. In support of this procedure:

- Each worker is expected to point out and insure correction of poor radiological work practices whenever they occur. In most cases, all that should be necessary is calling attention to the problem.
- All workers are expected to respond positively to radiological cautions provided by a co-worker.
- There may be situations where a formal stop-work is necessary. Any worker trained on this procedure is authorized to stop radiological work when the conditions defined in the following are met.
- All personnel are expected to immediately abide by a stop-work instruction.

It should be noted that the supervisors do not need to invoke a Stop-Work Order in exercising their normal responsibilities to monitor work in progress and to ensure proper adherence to BNL practices.

Whenever poor radiological performance is observed, workers should provide immediate advice to correct the problem**.** In most situations, a formal stop-work is not needed. The concern should be addressed quickly without participation and review by other than the involved workers. The imminent occurrence of the following examples are the types of situations that should be immediately corrected with a cautioning:

- Entry into a Controlled Area without proper training or escort.
- TLD worn on the wrong location on the body.
- Work about to begin without observing expected requirements.
- Removal of material without observing exit survey requirements from a location controlled as a Contamination or Activation Area.
- Beginning work without adequate Work Planning or training qualification.
- Touching the face or other exposed skin while working in a contamination area.
- Survey for radioactivity performed in a hasty manner.
- Disturbance of radiological postings or barriers.

Each of these activities, if not promptly addressed, could lead to a violation of federal and BNL radiation protection requirements.

There may be occasions when an employee observes a practice that is most likely a violation already, or possesses the potential to result in significant radiological exposure or release of radioactive material. In these situations, the work should be immediately stopped through a formal "Stop-Work" instruction; and follow-up reviews conducted to correct the problem prior to work continuing.

Examples of this type of situation are:

- Discovery of work that is being conducted without adequate Work Planning, such as work in a High Radiation Area or a Contamination Area without a RWP.
- Blatant or repeated disregard of established radiological requirements or direction from a health physics technician.
- Operation of radiation-producing equipment with interlocks bypassed without prior review and approval.
- Radiological controls that are inadequate for work in progress as evidenced by:
- Unplanned exposures greater than 25 mrem to a visitor or minor, or greater than 100 mrem to a worker.
- Two or more skin contaminations during any single phase of the work.
- Any single skin contamination >50,000 dpm/100cm^2.

In these situations, the work should be stopped by any trained individual using the following language. "**Stop work. You are in violation of radiological requirements because…"**

When a stop-work order has been given, the following actions shall occur:

- All work in the affected activity shall stop as soon as possible.
- The work place shall be placed in a safe condition.
- All workers shall report to the responsible line manager.
- Work shall not resume until appropriate safety reviews are performed and restart is authorized by the C-A Department Chair or his designate, subject to the

advice and counsel of the affected ESH Coordinator(s) and the BNL Radiological Control Manager.

REMOVING DAMAGED EQUIPMENT FROM SERVICE

If any equipment presents an immediate hazard that could reasonably be expected to cause serious injury or environmental harm, then you must remove it from service (e.g., broken ladders, frayed slings, defective power cords, leaking tanks).

WASTE DISPOSAL

CAUTION:

Improper disposal of radioactive or hazardous waste may result in fines, criminal prosecution, and facility shutdown. Contact the C-A Environmental Coordinator (x7520) well in advance to establishing any airborne, liquid or solid radioactive- or hazardous-waste-stream. The C-A Environmental Coordinator is familiar with rules, permits, authorizations and analysis requirements necessary for proper disposal

Removing waste from the Laboratory is complex and costly. Your cooperation is necessary in order to control waste according to Federal, State, and Suffolk County regulations. Additionally, the regulations of States where waste from C-A is ultimately disposed of must also be followed.

- Do not place clean materials in radioactive waste bins.
- Do not place radioactive materials in the green 3-yard bins used for clean waste.
- Substitute reusable or environmentally friendly materials where possible.
- Use minimum quantities of materials.
- Segregate wastes.
- Do not leave unnecessary items in primary areas.

Each person is responsible to ensure that they handle, accumulate or dispose of waste by using adequate controls and documentation. Waste generators at the C-A must check all waste to ensure that it is not radioactive. Generators of hazardous or radioactive waste at the C-A must be trained as per SBMS Subject Areas on Hazardous and Radioactive Waste Management should minimize the amount of waste they generate by substituting re-usable materials where possible, irradiating or using minimum quantities of materials, and segregating different wastes to allow for reclamation.

For example, we re-use radioactive lead whenever possible since it would become a mixed hazardous and radioactive waste.

Hazardous waste is subject to time limits and volume limits that must be strictly adhered to. Generally, accumulation of more than 55 gallons at a satellite accumulation area is not allowed. Once the waste is moved to the C-A Hazardous Waste Trailer, a 90-day clock starts. The waste must leave the C-A complex within this 90 day period. Containers must be appropriate for the type of waste being collected and be dated and labeled. Your cooperation in this area is important in order to maintain C-A's good reputation in the surrounding community.

Activated lead is an example of mixed waste. It is both hazardous and radioactive.

Do not put mixed waste in radioactive waste cans. Do not mix liquids with dry radioactive waste. Aside from activated Pb, another example of mixed waste is activated oil.

Do not throw clean metals into waste cans used for ordinary clean waste. Non-radioactive metals should be re-cycled. Metals in our clean waste stream are a problem since the Brookhaven Town Landfill will refuse BNL's clean waste if they find metal in it.

The C-A wishes to minimize radioactive waste, which is currently between 3000 and 4000 ft^3 per year. Packaging materials, coffee cups and the like should not be thrown into the radioactive waste cans. Do not put ordinary clean waste in the radioactive waste stream. This increases the radioactive waste cost. The current cost is about \$150 per ft^3.

Question: you have to throw out empty cans of a liquid chemical, which you have used, to clean equipment. You realize the liquid itself may require special handling, but the containers are dry. What do you do?

Answer: initially treat the container as hazardous waste and contact the C-A Environmental Coordinator (x7520) to learn the proper disposal technique.

Question: you have sweepings from a Building that has Radioactive Materials Work Areas inside it. You normally place sweepings in the green 3-yard bins used for clean industrial waste and there is one nearby. What do you do?
Answer: initially treat the sweepings as radioactive and contact HP to have the sweepings checked prior to putting it in the green bins. Radioactive waste WILL BE detected in either the green bins or the 50-yard garbage trucks and C-A WILL INCUR significant expense to sort and remove it. Remember that saving a few minutes by not having it checked by an RCT would cost C-A many person-hours later. Even low-level radioactive waste will be detected by the ultra-sensitive truck monitor. Do not assume that low level waste will be able to make its way unnoticed into the Brookhaven landfill.

SPILLS

The C-A is required to report spills. The C-A must always report quickly to outside agencies on events that deal with impacting the environment. Even minor events such as spilling any amount of oil in an outdoor area may require reporting. The rules are such that we must *consider* reporting spills of any type or size. IF you spill any hazardous liquid or oil outdoors on the bare soil or if you spill 5 gallons or more of hazardous liquid or oil on any impervious surface, THEN call x2222 or 911 (631-344-2222 from a cell phone), contact the C-A Main Control Room (x4662), the C-A ES&H Coordinator (x7200 or x4617) or the C-A Environmental Coordinator (x7520) as soon as you can. DO NOT leave a message on an answering machine. Report the spill giving your name plus information on the location of the spill and the type of material involved if you know it.

Spills that do not have to be reported are spills that occur as a result of routine operations as long as the following conditions are met:

- The spill occurs indoors.

- The spill occurs on an impermeable surface.
- The material spilled is not a highly toxic or highly volatile material (such as methylene chloride).
- The material spilled is not known to contain (or suspected to contain) polychlorinated biphenyls (PCBs).
- The person reporting the spill has appropriate training and materials to clean up the spill.
- The spill is cleaned up immediately.

The ES&H coordinator is to be contacted in the event of a spill to evaluate and coordinate the clean up efforts.

ENVIRONMENTAL MANAGEMENT SYSTEM

The goals of the Environmental Management System are to ensure that you know and comply with environmental regulations associated with your work. That you know the potential environmental aspects and impacts associated with your work and how to prevent, respond and mitigate impacts. Strive to practice the techniques of pollution prevention and waste minimization. BNL employees the EMS program defined by the International Standard, ISO 14001. There are five points to BNL's policy and commitment.

1) Pollution Prevention
Strive to prevent pollution, minimize wastes and conserve resources.
2) Compliance
Comply with all applicable environmental requirements.
3) Clean Up
Aggressively correct and clean up existing environmental problems.
4) Continual Improvement
Protect our ecosystem and community by continually improving the way we manage our programs.
5) Community Outreach
Openly communicate our progress and performance to our community and stakeholders.

Brookhaven's Environmental Stewardship Policy:

It is Brookhaven National laboratory policy to integrate Environmental Stewardship into all facets of the laboratory's missions. We will manage our programs in a manner that protects the ecosystem and public health. In support of this policy, Brookhaven makes the following commitments:

We are committed to achieving compliance with applicable environmental requirements.

In consideration of the potential impacts of our activities on the environment, we will integrate pollution prevention/waste minimization, resource conservation, and compliance into all of our planning and decision-making. We will adopt cost-effective practices that eliminate, minimize or mitigate environmental impacts.

We will define, prioritize, and aggressively correct and clean up existing environmental problems.

We will work to continually improve our environmental management system and performance. We will establish appropriate environmental objectives and performance indicators to guide these efforts and measure our progress.

We will maintain a positive, proactive and constructive relationship with our neighbors in the community, regulators, the Department of Energy, and our other stakeholders. We will openly communicate with stakeholder on our progress and performance.

In addition to my annual review of Brookhaven's progress on environmental goals and adherence to this policy, I invite all interested parties to provide me with input on our performance relative to this policy, and the policy itself.

Dr. John Marburger
Director

The work that you perform may have potential environmental impacts associated with it. If so, you will be required to observe specific controls designed to prevent such impacts. Your supervisor can explain those controls, or you may contact the C-A Environmental Compliance Representative (x7045) for details.

COMPRESSED GAS SAFETY

All compressed gases are hazardous due to high pressure. Compressed gases may also be hazardous because they *are*:

TOXIC: Gases that are poisonous in varying degrees ranging from extremely dangerous to life to only an irritant. Exposures to the more toxic gases can cause severe illness or death. Typical examples of poisonous gases are Sulfur Hexafluoride, Carbon Monoxide, and Hydrogen Sulfide.

FLAMMABLE: A condition that results when even small quantities of a specific gas when mixed with air, forms a mixture that is capable of being ignited. Once ignited, the burning gas mixture can ignite other nearby combustible materials. Typical flammable gases are Acetylene, Hydrogen, and Methane.

CORROSIVE: Corrosive materials can cause visible destruction or irreversible injury to human skin and eyes (similar to a burn) at the site of contact or can cause serious degradation of various construction materials, such as steel, or brass. An example of a corrosive gas is Chlorine.

OXIDIZERS: A gas that supports or enhances combustion. These gases must be handled with caution since they increase the potential of fire or explosion. They require special storage considerations. Typical oxidizer gases are Oxygen, Chlorine, Fluorine, and Nitrogen Oxides.

ASHYXIANT (oxygen displacement): Asphyxiation is a condition which results when a gas reduces the concentration of breathable oxygen to a hazardous level in air by displacing and diluting normal air. Typically all gases other than oxygen and air can do this.

CYLINDER RECEIPT AND CONTENT IDENTIFICATION

Because of the different hazards associated with different gases, it's important that cylinders be properly labeled. When a cylinder is delivered to the gas warehouse, a laboratory, or a job site, it should have:

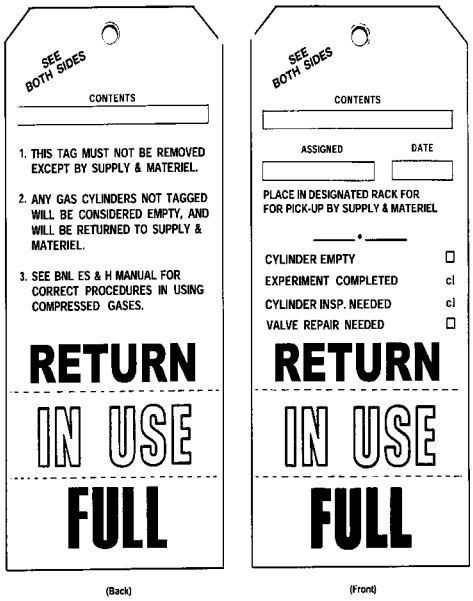
- **content identification**,
- **DOT label**, and
- **a valve protection cap**.

UNDER NO CIRCUMSTANCE should the means of identification be removed from a cylinder. The valve protection cap should remain in place until the user has secured the cylinder to a fixed support at the point of use and is ready to attach a pressure regulator to withdraw the contents.

Sometimes cylinders are received with no identification other then color code. There is no uniformity in the identification of cylinder contents through color coding of the cylinders. **Under no circumstances should such cylinders be accepted.**

DOT labels have a minimum of precautionary handling information and will classify the cylinder contents.

The personnel at the BNL Gas Warehouse will attach a Cylinder Status Tag on the cylinder when it is delivered. Tear off the bottom of the Cylinder Status Tag and write name of assigned user on tag indicating the cylinder is in use.



GENERAL RULES FOR CYLINDER HANDLING

- Do not drop cylinders or permit them to violently strike each other.
- Do not roll cylinders in a horizontal position.
- Do not drag cylinders.
- Do not handle cylinders with oily hands or oily gloves. This is especially important when handling oxygen and other oxidizers.
- If hoisting is necessary, use a suitable cradle or platform.
- Do not lift a cylinder by its cap.
- Keep cylinder caps on the cylinder whenever they are not in use.
- Transport cylinders using a cart or hand truck designed for that purpose, securing the cylinders.
- Whenever placing a cylinder in service, check the hydrostatic test date. If a cylinder is not in service it must have a hydrostatic test performed every five years.

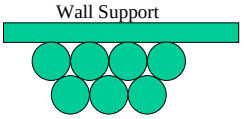
COMPRESSED GAS CYLINDER SAFE STORAGE

- Storage areas should be dry, cool, and well ventilated, and where practical, fire resistant.
- Gases of different types are to be grouped by type and non-compatible types should be separated. Flammable gases shall not be stored with oxidizing gases.
- Cylinder storage areas are to be prominently posted with the types of gases stored.
- Charged and empty cylinders should be stored separately.
- Cylinders should be arranged so that old stock can be removed first with a minimum handling of other cylinders
- Cylinders should not be stored at temperatures above 125 ^{0}F, (51^{0} C) or near sources of heat.

- Cylinders should not be stored near highly flammable or combustible materials.
- When cylinders are being moved on a cylinder cart, pallet, or truck, they must be secured.

Safe methods for securing capped compressed gas cylinders in storage include the three-point contact system. This is done by restraining cylinders in a tight mass using a contiguous three-point system with other cylinders or solid support structure. All compressed gas cylinders shall be secured to prevent falling. An appropriate method for securing cylinders is by providing a substantial chain, which is positioned in front of, or around the cylinder(s) and secured to a solid structure.

Three Point Contact System



All cylinders are in contact on three points either with other cylinders or the wall

RESPONSE TO FIRE OR OTHER EMERGENCY

IF you work in a primary area, THEN make a mental note of:

- Exits.
- Fire Alarm Pull Boxes.
- Crash buttons.
- Crash cords.
- Inter-phones.
- Emergency exhaust, if any.
- Telephones.

Question: you need immediate help in an emergency. What do you do?

Answer: pull a fire alarm box or call x2222 or x911 (631-344-2222 from a cell phone) or call the MCR x4662. All of these are OK.

Question: there is a fire near the tanks on your acetylene-welding unit. What do you do?
Answer: warn others and evacuate the building.

In any emergency, one can and is encouraged to pull a fire alarm box; it does not have to be a fire. Fire alarm boxes are located throughout the accelerators, at the entrances to target caves, experimental halls, and the Collider tunnel. They are the best method to simultaneously alert MCR and the ES&H Fire/Rescue Group. Pulling a fire alarm box brings the Fire/Rescue Group to your specific alarm-box location within two minutes, and appropriate additional personnel can be summoned right away.

Rings and caves are restricted spaces. If fire should break out, then smoke could quickly impair visibility, and asphyxiation from smoke is a possibility. If fire breaks out, then get out immediately. There are two escape hatches in the accelerator Ring. One is at K7 and the other at C14 in addition to north and south gates. Emergency exit signs will point you to the nearest exit. Next to the escape hatch in the Accelerator Ring is the emergency exhaust button that when activated will pull the smoke away from hatch.

At the Collider Tunnel, Vertical and horizontal emergency exits alternate and are located throughout the tunnel. At the intersection areas there are multiple horizontal exits. All exits go to the inner ring road.

Once outside a smoky area, report to the Local Emergency Coordinator (LEC) or the Department Emergency Coordinator (DEC) if they are present. They will be wearing baseball-like caps marked DEC or LEC. Do not chat with the Fire Captain or other emergency response personnel in the area. Obey the directions of the Fire Captain, DEC or LEC.

C-A ALARM SIGNALS

Even if you are inside a C-A primary area, then you must obey the emergency signals as follows:

RESPONSE TO FIRE ALARMS

If you hear an Intermittent Fire Alarm Bell, evacuate the area after placing equipment in a safe operating mode. The Main Control Room Personnel, Operations Personnel, and Hydrogen Target Watch Personnel must remain on station if they have emergency duties, but will evacuate during imminent danger situations. Personnel will then assemble in the designated Assembly Area. If You hear a continuous Fire Alarm Bell evacuate the area through the nearest exit assemble at least fifty feet from the building or a designated outside assembly area and obey the directions of the Fire Caption, DEC, or LEC.

RESPONSE TO FLAMMABLE/EXPLOSIVE GAS ALARMS

If you hear a two-tone horn in the Collider experimental areas complex accompanied by a yellow strobe, evacuate immediately and report to an outside assembly area.
If you hear a pulsating Klaxon on the accelerator experimental floor (building 912), evacuate immediately and report to an outside assembly area.

BNL SITE SIRENS

- IF you hear a continuous site-wide siren for five minutes, THEN leave the area and assemble in the indoor assembly area posted on all entrance doors.
- IF you hear a pulsating site-wide siren, THEN evacuate the BNL site.

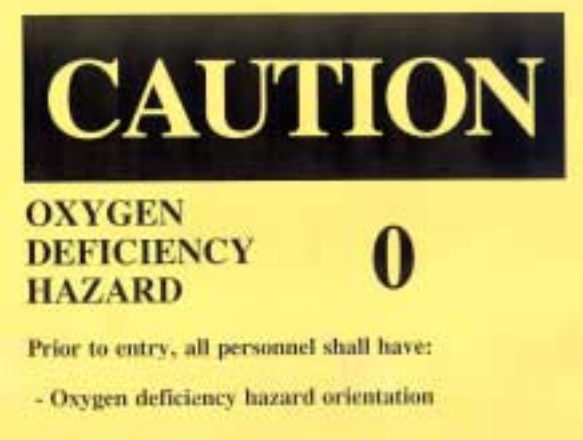
The site evacuation plan covers other facilities on-site. The site sirens are tested each Monday at noon.

ACTIONS FOLLOWING AN INJURY/ILLNESS

- If there is an emergency involving an injury or an illness such as a heart attack, THEN pull the fire alarm box, or call x2222 or x911.IF you are injured on the job, THEN report as soon as possible to the BNL Occupational Medicine Clinic, which is located in Building 490. After house report to the Fire House. Your supervisor should accompany you. If your supervisor is not available, you must call upon another member of supervision or management in your Department or Division to go with you. In most circumstances, it is expected that you report to the clinic immediately after the injury. If this is not possible, you are required to notify the Clinic immediately and report to the Clinic with your

supervisor, or alternate member of management, before the end of the work shift in which the injury occurred, or at the start of your next work-shift. If you fail to notify as required, any resulting missed work may be considered unauthorized leave and will be ineligible for sick leave.

OXYGEN DEFICIENCY HAZARDS



What is oxygen deficiency? Normal atmospheric content is 20.9% oxygen, 78% nitrogen, and 1% argon. Oxygen deficiency is defined as less than 19.5 % oxygen. This happens when air in an enclosed space is displaced by another gas.

What causes oxygen deficiency? Cryogenic systems use large amounts of helium and nitrogen. Both liquids expand about 700-800 times when released into air. This could happen quickly with a major release as a result of catastrophic failure. In a major release, one might see a rapidly expanding white cloud and hear a "whooshing " sound. The leak could also be slow, invisible and silent. Both helium and nitrogen are colorless and odorless.

Sulfur hexafluoride (SF_6), a noncombustible, colorless gas, with a slight sulfur like odor. This gas which is heavier than air, is used at the Tandem Van de Graff as an insulating gas. A oxygen deficiency hazard may occur in the event of a large release of this material. Since this material is heavier than air, some low laying areas, basements and pits have been designated as an ODH 0 area.

Carbon Dioxide, used to extinguish fires, is an odorless, colorless gas, which also displaces oxygen. Building L18 in the AGS has enough CO_2 extinguishes to cause a serious oxygen deficiency. If you need to enter the L18 house, you will require special training and a bypass key. Consult with your supervisor or the C-A ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605).

EFFECTS OF OXYGEN DEFICIENCY

The following table summarizes the health effects of oxygen deficiency.

Volume % O	Effect on Healthy Person	Approximate Time
17	Deep Breathing Faster Heartbeat	Rapidly
16	Dizziness, Slower Reaction Time	Rapidly
15	Impaired Attention And Coordination, Intermittent Breathing, Rapid Fatigue, Loss Of Muscle Control	Rapidly
12	Very Faulty Judgment, Inability To Move, Loss Of Consciousness, Brain Damage	10 Min 10 Min 2 Hours
10	Inability To Move, Nausea, Vomiting, Loss Of Consciousness	4 Min 10 Min
6	Loss of Consciousness Coma Death	30 sec 1 min 5 min

CLASSIFICATION LEVELS OF ODH

There are five classes: 0 through 4, with 0 being the least hazardous. Classification is based on the likelihood of fatality. There are no areas at C-A with classification greater than Class 1. Two areas, 1005R refrigerator and g-2 refrigerator are Class 1. Additional control measures and training are required for entry into a Class 1 ODH area. You are not permitted to enter Class 1 ODH areas without the additional training.

This access training allows you to enter the following Class 0 areas at C-A:

- g-2 Compressor Building,
- g-2 Muon Ring Storage Building (High Bay), and
- EVA Compressor Room (E850), EEBA Rectifier House #3.
- Collider Buildings with valve boxes.
- Support Buildings 1002B, 1004B, 1006B, 11008B.
- Compressor Buildings 1005H and 1005E.
- Collider Tunnel

WHEN IS EVACUATION OF AN ODH AREA REQUIRED?

Any one or combination of the following requires an immediate evacuation of an ODH area:

- The in-place oxygen monitors set off an alarm. At the Collider complex, Blue strobes lights accompany the audible alarms. In building 1005H there is no audible alarms but a red strobe light.

- A vapor cloud is observed inside the ODH area or a loud "whooshing" sound is heard (even if no alarm sounds).

The evacuation procedure is as follows:

- Leave the area, moving away from any vapor cloud or other potential problem.
- Stay Low! Do not use vertical escape exits, use only horizontal exits if the gas is lighter than air such as helium or nitrogen.
  If the gas is heavier than air such as sulfur hexafluoride, located at the Tandem Van de Graff, do not exit through low areas. Leave low areas immediately.
- If someone is in danger, hurt or feeling ill, call 2222 or 911. Otherwise, call the Control Room.

It is important to remember that you should not re-enter even with an escape pack. Let the Fire/Rescue Group handle it. ODH deaths usually come in pairs; more than 50% of ODH deaths are of would be rescuers. One or two breaths could cause loss of consciousness under certain conditions, and lung damage is possible if the gas cloud temperature is -50 to -70 ºC.

EMPLOYEE CONCERNS PROGRAM

The Laboratory wants your work related problems and complaints to be solved fairly and promptly. Many problems can be resolved by working within the supervisory structure of the department. If for any reason this approach does not work for you, the BNL Employee Concerns Program offers employees a different alternative. The Employee Concerns Program is designed to give employees the opportunity to confidentially communicate issues of concerns related to waste, fraud, and abuse of health, safety, and environmental issues when they feel unsatisfied with the response of the line management or ES&H specialist. Contact Program Manager ext. 2888.

OUTDOORS SAFETY CONCERNS

All New York State laws must be followed. The site speed limit is 30 mph. Obey all parking and traffic postings. The deer on site also present a driving hazard to which you should be alert.

On the BNL site you will see a variety of wildlife. Many of the deer and some other animals carry the deer tick, which can transmit Lyme disease. Avoid high grass and wet wooded areas. For more information about Lyme disease contact the C-A ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605) or the Occupational Medicine Clinic.

COUNTER-INTELLIGENCE PROGRAM

The Department of Energy is known worldwide as a stronghold of scientific expertise, and as such, is of prime interest to foreign intelligence services. To help protect it’s intrests, the DOE established the Counterintelligence Program. All BNL employees are required to report contacts with foreign nationals and all travel to sensitive countries. For information about this program or to report any concerns

contact the BNL Counterintelligence Program Manager (x2234).

LABORATORY COMPUTERS

Laboratory computers are provided to staff in order to support Laboratory operations. You must be authorized to work on a computer and use it in accordance with BNL requirements. The BNL Computer Users Agreement defines the acceptable parameters for computer use.

You are responsible for the security of your computer and its stored data. Information created, stored, and processed at BNL is considered BNL property and must be protected. If at any time, you suspect that the security of your computer has been compromised, contact your supervisor immediately.

BNL SECURITY

The Police Group, part of BNL's Safeguards and Security Division, is responsible for providing protection to BNL employees, property, and equipment, as well as controlling sensitive and classified information.

Identification badges, security clearances, and property passes aid in the security process. Photo identification badges are issued to all employees, visitors and guests. ID badges should not be left in the open. If you loose your ID badge contact the Security Division to have another issued.

A property pass is required any time you remove BNL property from the site. BNL reserves the right to inspect and search vehicles entering or leaving the site. For more information about security or if you are required to work with sensitive material contact Security Division (x2238)

STAFFING LEVELS AND SAFETY

Rules shall be followed even when you are short-handed. Do not violate safety rules to get the job done. For example, do not go down one-way streets the wrong way although you get to the job-site quicker. Do not climb cable tray because it takes more time to get a man-lift. Do not use a procedure that you have not been trained on although you feel it will please your supervisor. In short, there are no economics for safety. It will always be cheaper to do the job right the first time. There is only a cost for failure, and experience shows this cost can be spectacular.

ACCOUNTABILITY FOR NOT FOLLOWING THE RULES

Perform exactly the requirements in C-A procedures or cause those requirements to be officially changed to what the C-A Department needs. This policy applies to all C-A Groups and will be enforced everywhere. You will be held accountable to follow rules and procedures for which you have been trained.

EMERGENCY EGRESS

Upon entering any building or experimental At the C-A complex one should note the locations of emergency equipment as well as the exit points.

SPECIAL REQUIREMENTS FOR SPECIFIC EXPERIMENTS

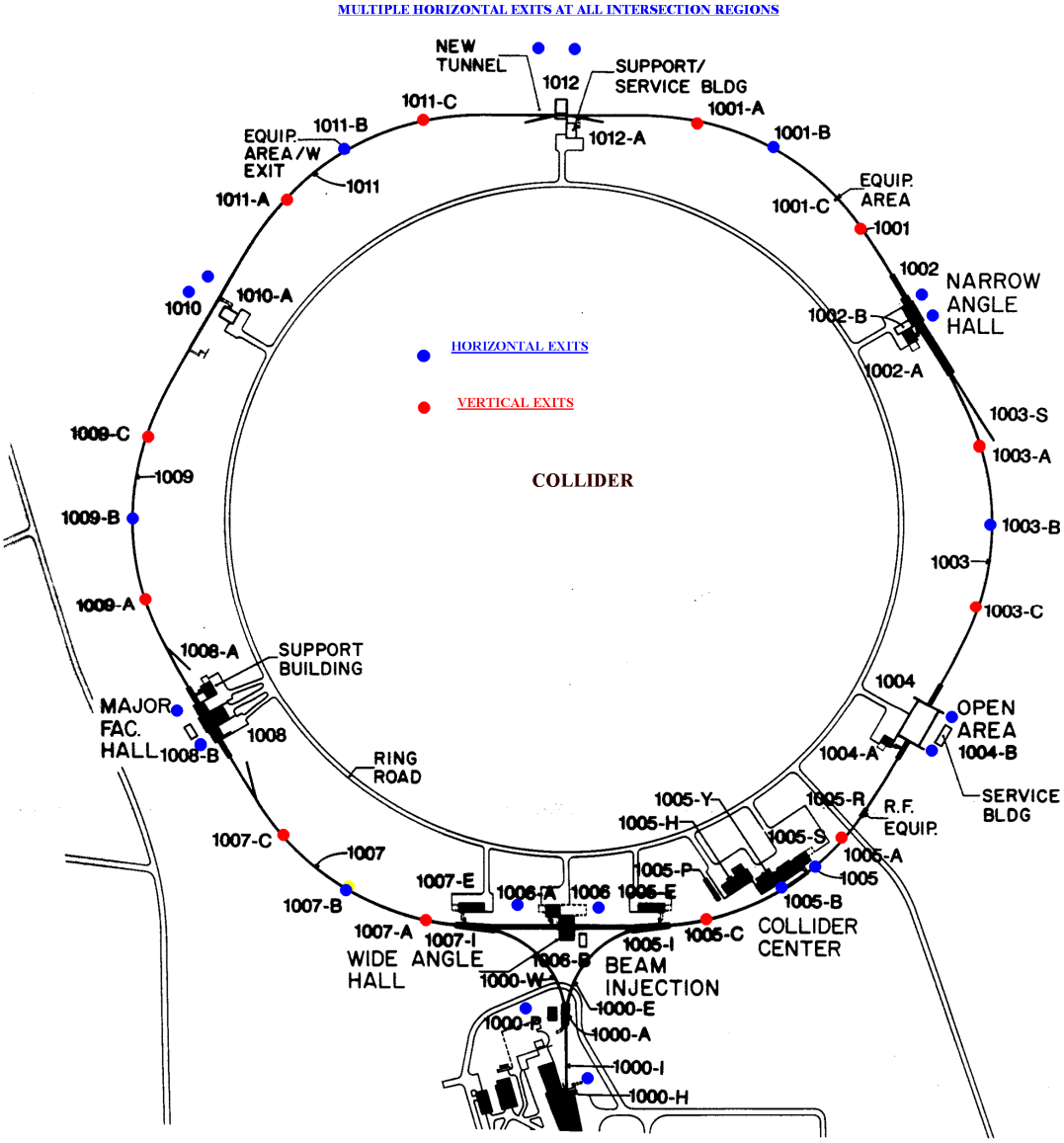
PHENIX

- All work must be pre-approved by Supervisor or Subsystem Manager AND Run Coordinator/Shift Leader prior to working in IR.
- Two person rule in effect in the IR.
- Hardhat and Safety Shoes required for work. This experiment is still a construction area.
- Flammable/explosive gas in the experimental area. Use no ignition sources.
- Fall protection / training required for work performed at elevations over six feet.
- No Loitering about power distribution areas, gas storage/handling areas and transformer yards.

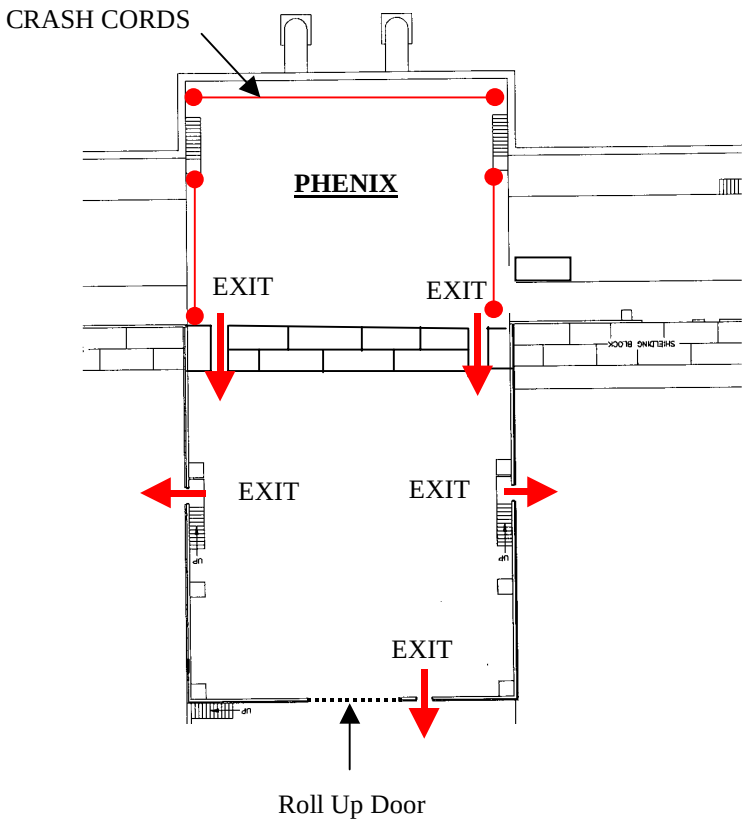
STAR

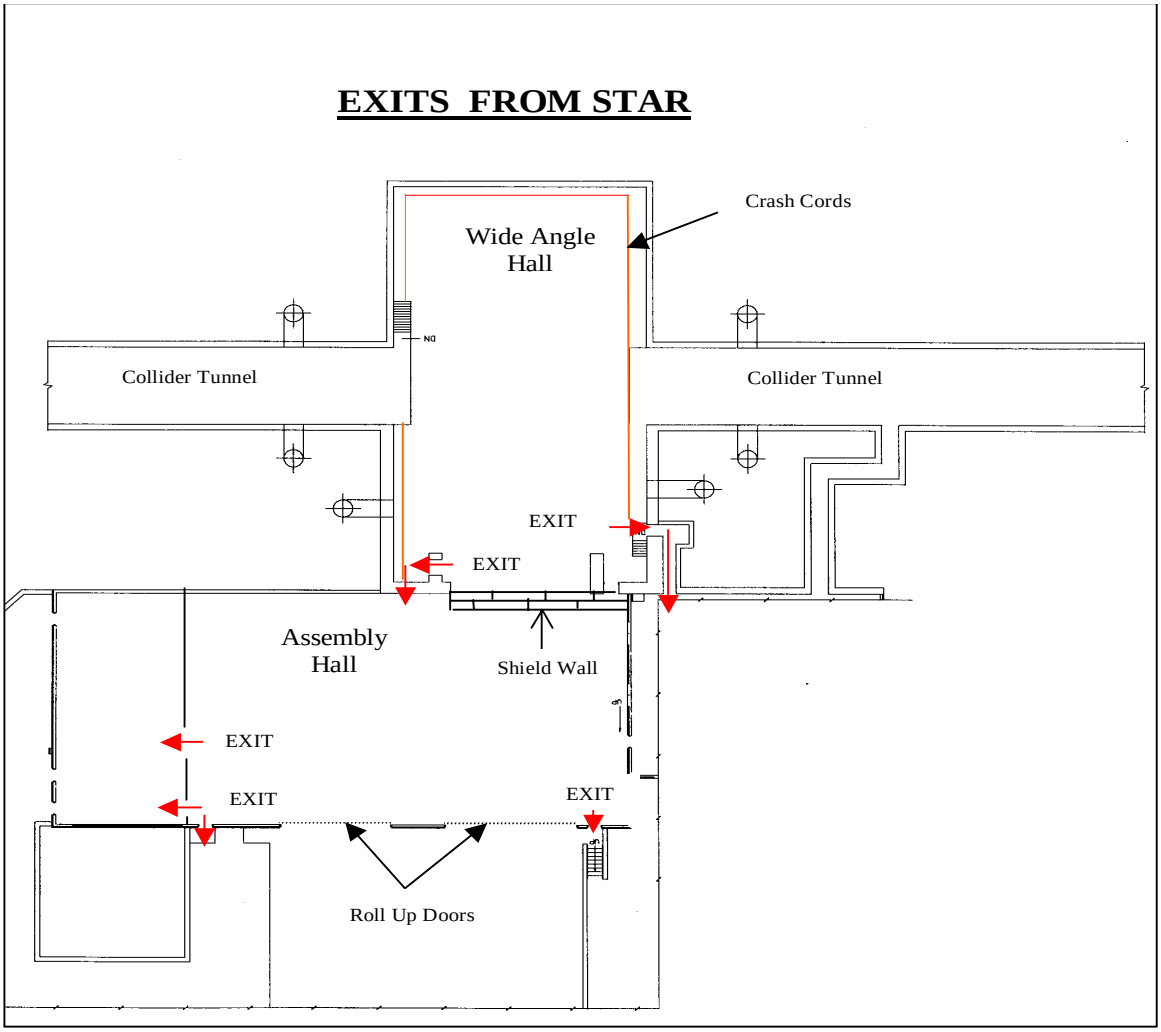
- Fall protection / training required for work performed elevated over four feet.
- Hardhat required if people are working above you or overhead crane is in operation.
- Lasers in use in the area.
- Flammable/explosive gas in the experimental area.
- No Loitering about power distribution areas, gas storage/handling areas and transformer yards.

EXITS FROM COLLIDER TUNNEL

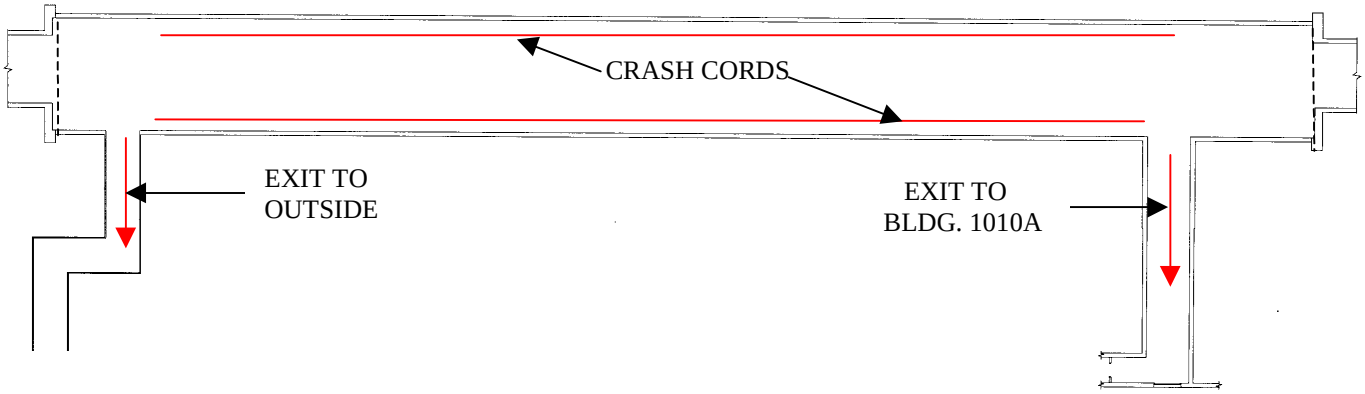


EXITS FROM PHENIX

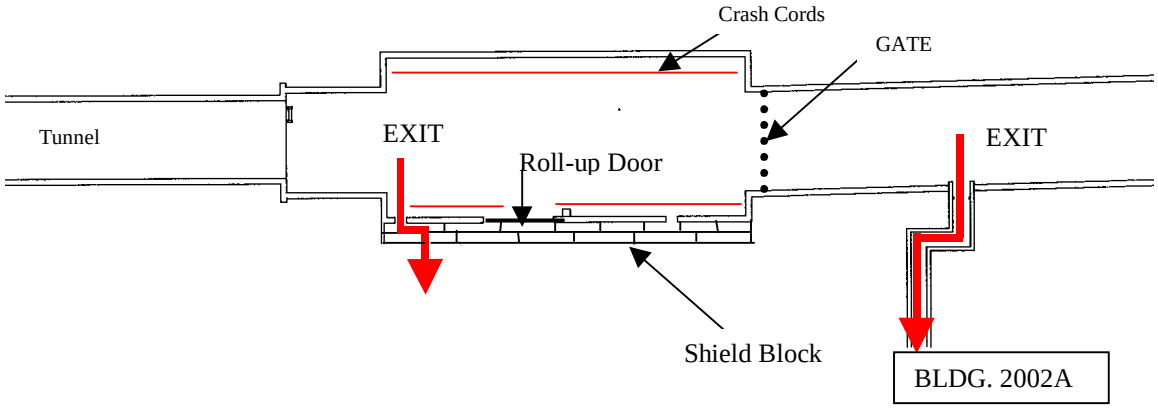



EXITS FROM STAR
Crash Cords
Wide Angle Hall
Collider Tunnel
Collider Tunnel
EXIT
EXIT
Assembly Hall
Shield Wall
EXIT
EXIT
EXIT
Roll Up Doors

EXITS FROM PHOBOS



EXITS FROM BRAHMS



LIST OF ACRONYMS

AGS - Alternating Gradient Synchrotron
ALARA - As Low As Reasonably Achievable
BNL - Brookhaven National Laboratory
BSA – Brookhaven Science Associates
C-A – Collider Accelerator Department
DEC - Department Emergency Coordinator
DOE - United States Department of Energy
ES&F - Experimental Support and Facility Support Division, a Division of the C-A Department
FEB - Fast Extracted Beam
HP - Health Physics
IR – Intersecting Region
LEC - Local Emergency Coordinator
LOTO - Lock Out Tagout
MCR - Main Control Room
OC - Operations Coordinator
ODH – Oxygen Deficiency Hazard
OSHA - United States Occupational Health and Safety Administration
PAAA – Price Anderson Act Amendments
RCT- Radiological Control Technician
RWP - Radiation Work Permit
SEB - Slow Extracted Beam
SRD - Self-Reading Dosimeter
TLD - Thermo-Luminescent Dosimeter